

**Focused Corrective Measures Study
The Boeing Company Tract 1
Hazelwood, Missouri
MOD000818963**



Prepared for:
**The Boeing Company
Boeing Defense, Space and Security
P.O. Box 516, MC S111-2491
St. Louis, MO 63166-0516**

Prepared by:
**RAM Group of Gannett Fleming, Inc.
5433 Westheimer Road, Suite 725
Houston, TX 77056
Ph: (713) 784-5151
Fax: (713) 784-6105
e-mail: asalhotra@ramgp.com**

RCRA



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February 2012

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Fax: (713) 784-6105
[e-mail: asalhotra@ramgp.com](mailto:asalhotra@ramgp.com)**

February 2012

The Boeing Company
P.O. Box 516
St. Louis, MO 63166-0516
(314) 232-0232

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AWMD/WRAP-KNRP

Ms. Christine Kump-Mitchell, P.E.
Environmental Engineer, Permits Section
Missouri Department of Natural Resources
Hazardous Waste Program
7545 S. Lindbergh, Suite 210
St. Louis, MO 63125



RE: Corrective Measures Study, The Boeing Company Tract I, Hazelwood, Missouri,
MOD000818963

Dear Ms. Kump-Mitchell:

Enclosed is the Corrective Measures Study (CMS) for the Boeing Tract I site. This document was prepared as a *focused* CMS, based on the approved Work Plan and subsequent discussions with the Missouri Department of Natural Resources (MDNR). As a *focused* CMS, the agreed approach did not require the evaluation of various remedial alternatives. Two hard copies and one CD are enclosed. One hard copy and one CD have also been submitted to Ms. Amber Whisnant at the United States Environmental Protection Agency (USEPA) Region VII. The City of St. Louis Lambert International Airport and GKN Aerospace will be provided copies for review as well.

The MDNR and USEPA approved the Corrective Measures Study Work Plan in a letter dated July 7, 2010. The CMS was prepared in accordance with the work plan and Section VII of the Corrective Action Conditions of the Missouri Hazardous Waste Management Facility Part I Permit MOD000818963.

The Boeing Permitted Facility Excavated Soil Management Plan that was previously approved by Boeing, Airport, GKN, and MDNR will be modified to reference the need for a site-specific Health and Safety Plan (HASP) to protect the construction worker in specific impacted areas of the site, namely Sub-areas 2B and 6B, where the target risk was exceeded. The need for a HASP in these areas is also referenced in the CMS and will be referenced in the associated final approved Covenant.

Please contact me if you have any questions at (314) 777-9181, or Dr. Atul Salhotra of the RAM Group of Gannett Fleming, Inc. at 713-784-5151.

Sincerely,

A handwritten signature in black ink, appearing to read "Joe Haake".
Joseph W. Haake
Environmental Scientist

cc: Amber Whisnant, USEPA Region VII
Rich Nussbaum, MDNR
Bruce Stuart, MDNR

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ABBREVIATIONS

AUL	Activity and Use Limitation
AST	Above-ground Storage Tank
bgs	Below Ground Surface
BNI	Bechtel National, Incorporated
Boeing	The Boeing Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
COC	Chemical of Concern
cyd	Cubic Yards
DCE	Dichloroethene
DRO	Diesel Range Organics
DWS	Drinking Water Standard
EPC	Exposure Point Concentration
ft	Feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
gpm	Gallons per Minute
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
HI	Hazard Index
HISS	Hazelwood Interim Storage Site
HQ	Hazard Quotient
HRC®	Hydrogen Release Compound
IELCR	Individual Excess Lifetime Cancer Risk
ISCO	In-Situ Chemical Oxidation
lbs	Pounds
LNAPL	Light Non-Aqueous Phase Liquid
MACTEC	MACTEC Engineering and Consulting, Inc.
MDNR	Missouri Department of Natural Resources
mg/L	Milligrams per Liter
MNA	Monitored Natural Attenuation
MRBCA	Missouri Risk-Based Corrective Action
ORO	Oil Range Organics
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polycyclic Aromatic Hydrocarbon
PCE	Tetrachloroethylene
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance and Quality Control
RAGS	Risk Assessment Guidance for Superfund
RAM	Risk Assessment & Management Group, Inc.
RAM Group	RAM Group of Gannett Fleming, Inc.
RBCA	Risk-Based Corrective Action

RC	Representative Concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SLAPS	St. Louis Airport Site
SCOC	Selected Chemical of Concern
SMP	Soil Management Plan
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TC	Target Concentration
TCE	Trichloroethene
Tetra Tech	Tetra Tech EM, Inc.
TPH	Total Petroleum Hydrocarbon
µg/L	Micrograms per Liter
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

The Boeing Company (Boeing) Tract 1 Facility (site), USEPA No. MOD000818963, is located in Hazelwood, St. Louis County, Missouri and covers an area of about 228 acres. There have been numerous investigations at the site resulting in an approved Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) Report (1995), RCRA Facility Investigation (RFI) Report (2004), a focused Final Corrective Measures Study (CMS) Work Plan (2010), and risk assessment reports (2004 and 2008). The CMS was prepared as a focused CMS in coordination with and the approval of the Missouri Department of Natural Resources (MDNR). Several interim actions consisting of multiple soil removals, additions of bio-stimulants to enhance the natural attenuation of chlorinated solvents, and light non-aqueous phase liquid (LNAPL) removal have also been successfully implemented at the site.

As a result of these extensive investigations, source areas have been identified and interim remedial actions have addressed soil and groundwater impacts. Only residual impacts remain.

Interim remedial actions have included the following:

- Pre-RFI actions in Risk Areas/Sub-areas 1, 3D, and 4 have included removal of an above-ground storage tank (AST) and transformer, closure of a sump, cleaning and sealing surfaces in waste storage areas, and soil excavation and disposal (refer to Section 1.2.3.1);
- RFI actions in Risk Sub-areas 6B and 6C have included an enhanced bioremediation pilot test injection of 810 pounds (lbs) of Hydrogen Release Compound® (HRC) in the shallow groundwater zone via nine borings to address chlorinated solvent impacts, replacement of industrial wastewater sewer lines, and excavation and disposal of 75 cubic yards (cyd) of impacted soils (refer to Section 1.2.3.2);
- Post-RFI actions in Risk Sub-areas 2B, 3A, 3E, 6B, and 8B have included excavation and disposal of about 2,250 tons of impacted soils and placement of 8,000 lbs of HRC in the floor of an excavation to enhance biodegradation of chlorinated solvents (refer to Section 1.2.3.3); and
- Multiple LNAPL removal activities have been completed from 1990 to 2003 in Areas 1 and 2 (refer to Section 1.2.3.4).

Additional interim actions, as described in the Interim Measures Work Plan submitted to the MDNR in December 2011 (RAM Group, 2011b), will be implemented in 2012 after approval by the agencies. The proposed interim actions are a voluntary and pro-active measure and will consist of injection of in-situ chemical oxidation agents into the soil and groundwater in Sub-areas 2B and 6B to address residual chlorinated solvent impacts.

This focused CMS builds on these previous efforts and addresses the following four remaining issues at the site:

Issue No. 1: Sub-areas with risk exceedances;

Issue No. 2: Residual LNAPL in certain wells;

Issue No. 3: Exceedance of drinking water standards (DWS) in groundwater; and

Issue No. 4: Confirmation that future risk from complete exposure pathways associated with groundwater will not exceed regulatory acceptable risks; i.e., confirmation that the groundwater concentrations are at a minimum stable and preferably declining.

This document describes each of the four issues and presents the recommended actions to address each of these issues. Upon the successful completion of the pending interim actions (RAM Group, 2011b) and the actions recommended in this CMS, all permit requirements and outstanding issues related to past releases will have been addressed.

Issue No. 1: Sub-areas with Risk Exceedances. The agency approved risk assessments prepared by RAM (2004) and Tetra Tech EM, Inc. (Tetra Tech, 2008) indicated that the cumulative risks were within acceptable levels for all scenarios except for the construction worker for the following exposure pathways and areas: (i) potential dermal contact with groundwater in Sub-areas 2B and 6B, and (ii) outdoor inhalation of vapors from groundwater in Sub-areas 2C, 3H, and 6B. Sub-areas are shown on Figure 1-1. The CMS proposes to manage the residual potential future risks to construction workers using institutional controls established by activity and use limitations (AULs). Specifically, the controls include the collection and evaluation of data prior to construction activities in these areas and the development and implementation of health and safety plans (HASPs) prior to any construction to protect the construction worker. The HASP will include, as appropriate, monitoring requirements and the use of appropriate personal protective equipment based on the monitoring results. The HASP would be used in conjunction with the *Boeing Permitted Facility Excavated Soil Management Plan* (SMP) (Boeing, 2011a); already agreed to by the primary owners of the site (Airport, Boeing, and GKN) and approved by the regulatory agencies. As an added supplemental proactive measure, continuation of the interim remedial actions in Sub-areas 2B and 6B may provide further reduction of groundwater concentrations and contaminant mass.

Issue 2: LNAPL in Certain Wells. LNAPL or sheen was detected in 32 wells in four areas during the period 1990-2011. As a result of extensive LNAPL removal activities conducted from 1990 to 2003, LNAPL has only been detected in 14 wells since 2008 and these detections have been sporadic and at small thicknesses. The maximum thickness measured in any well has been less than 0.1 foot. Groundwater samples collected from wells with trace LNAPL in Areas 1 and 2 indicated the absence of dissolved phase volatile organic compounds (VOCs) and total petroleum hydrocarbons, with few exceptions as discussed in Section 4.0. The above observations indicate that LNAPL has been removed to the extent practicable and the presence of residual, immobile, and weathered trace petroleum hydrocarbons that do not contribute additional mass of chemicals of concern (COCs) to the groundwater remains. The focused CMS therefore recommends no further action related to this issue.

Issue 3: Exceedance of Drinking Water Standards. Groundwater data collected during the recent four monitoring events in 2008, 2010, and 2011 indicate 12 chemicals exceed DWS in four areas. At this site, there is no current groundwater use or future probability of groundwater use, low potential for off-site migration, and the localized plumes are stable. Therefore, the CMS proposes to use AULs as an added protective measure to prevent current and potential future groundwater use. These measures are sufficient to confirm that exposure to groundwater as a drinking water supply does not occur. Additionally, the application of monitored natural attenuation (MNA) is proposed to further reduce the groundwater concentrations. In two of the areas where chemical concentrations exceed DWSs, namely Sub-areas 2B and 6B, additional voluntary interim remedial activities are planned that may provide additional reductions in groundwater concentrations (RAM Group, 2011b).

Issue 4: Future Risk and Groundwater Concentration Stability. Except for the potential future risks to the construction worker, all other current and reasonable risks associated with the groundwater pathway were below MDNR-specified criteria. To ensure that these risks remain acceptable, it is necessary to confirm that the future groundwater concentrations do not increase. An increase in groundwater concentrations could increase the risk above the regulatory acceptable levels. Therefore, the CMS presents a monitoring plan to sample groundwater for the chemicals that contribute most to the risk. The CMS recommends that this monitoring be continued until it can be confirmed that the groundwater concentrations are stable/declining.

Upon approval of this focused CMS by the agencies, Boeing will submit a risk management plan to the agencies for approval.

SECTION 1.0 OBJECTIVE AND BACKGROUND

1.1 OBJECTIVE OF STUDY

The site is located in Hazelwood, St. Louis County, Missouri and covers a total area of about 228 acres (Figure 1-1). It is bounded by Lindbergh Boulevard to the west, St. Louis Lambert International Airport (Airport) to the south and southeast, Cold Water Creek to the east, commercially developed properties to the north and is traversed by Banshee Road and McDonnell Boulevard. The site properties are owned by The Boeing Company (Boeing), GKN Technologies (GKN), and the Airport, as shown in Figure 1-1.

The surrounding properties consist of commercial businesses, manufacturers, and maintenance facilities that are generally related to or support airport and aerospace manufacturing. The Formerly Utilized Sites Remedial Action Program (FUSRAP) North County Site consisting of the St. Louis Airport Site (SLAPS) and the Hazelwood Interim Storage Site (HISS) are located in the vicinity of the Boeing Tract 1 site. The SLAPS and HISS are sites that have been impacted by radioactive materials related to wastes generated during the Manhattan Project during World War II. The SLAPS is located adjacent to the east of the Boeing Tract 1 site across Coldwater Creek to the east of Sub-area 6D and monitoring wells MW6 and MW6D. The HISS is located farther to the north of the SLAPS and is not near the Boeing Tract 1 site.

The MDNR and the United States Environmental Protection Agency (USEPA) approved the *Final Corrective Measures Study Work Plan, The Boeing Company Tract 1* (RAM Group, 2010e) in a letter dated July 7, 2010 (MDNR, 2010b). Refer to Appendix A. This document presents the focused Corrective Measures Study (CMS) prepared in accordance with *Section VII, CMS Work Plan of the Missouri Hazardous Waste Management Facility Part I Permit MOD 000818963* and is consistent with the guidance contained in the USEPA document *RCRA Corrective Action Plan (Final), OSWER Directive 9902.3-2A* (USEPA, 1994).

The objective of this focused CMS is to identify, evaluate, and propose the preferred remedial actions for the releases that have been identified at the site and the residual impacts that remain following the previously completed extensive characterization and remedial activities. The CMS was prepared as a focused CMS in coordination with and the approval of the MDNR. The proposed remedial actions will address the specific areas where risk to human health and the environment, and groundwater impacts exceed MDNR-specified criteria. The recommended activities will ensure protection of human health and the environment under current and future conditions and continued reduction of the residual groundwater impacts. The proposed remedy and related activities are also consistent with USEPA's policies on protecting and cleaning up groundwater at RCRA facilities (USEPA, 2004) and the site permit (MOD 000818963). Subsequent to the approval of the focused CMS by the regulatory agencies, the recommended actions will be implemented in accordance with an approved risk management plan. In this regard, this CMS is the culmination of the prior work and addresses all remaining issues related to historic releases and use of chemicals at the site.

1.2 CHRONOLOGY OF RELEVANT ACTIVITIES

There have been numerous investigations at the facility including a RFA (SAIC, 1995); Underground Storage Tank (UST) removals/investigations; environmental assessments; and interim remedial activities. These previous assessments and remedial activities culminated in the approval of the RFI, risk assessment prepared by RAM, and focused Final CMS Work Plan.

1.2.1 Resource Conservation and Recovery Act Facility Investigation Report

The RFI was prepared by MACTEC Engineering and Consulting, Inc. dated December 2004 (MACTEC, 2004b). The objectives of the RFI were to:

- Determine the nature and extent of impact to the study areas;
- Determine the physical properties and characteristics of the affected media; and
- Obtain the necessary data to support the risk assessments and CMS.

The RFI divided the facility into 18 study areas based on the results of the previous assessments, investigations, location of Solid Waste Management Units (SWMUs), and interim remedial measures. The geology and hydrogeology are described in the RFI. Aquifer testing was performed and soil samples were collected for analysis of geotechnical parameters. Several soil borings were advanced and temporary piezometers, permanent piezometers, and groundwater monitoring wells were installed. Table 3-1 of the RFI (MACTEC, 2004b) presents a list of the monitoring wells. A few of these wells have been plugged and abandoned. Refer to Section 1.3.4 for the wells that are currently present. Soil and groundwater samples were collected, field parameters measured, and samples analyzed using approved laboratory methods for the following constituents:

- Volatile organic compounds (VOCs);
- Polycyclic aromatic hydrocarbons (PAHs);
- Semi-volatile organic compounds (SVOCs);
- Polychlorinated biphenyls (PCBs);
- Total and dissolved metals; and
- Total petroleum hydrocarbons (TPHs).

The primary conclusions of the RFI were that the (i) impacts to soil and groundwater have been adequately identified and delineated, and (ii) impacts are confined to the site and do not extend off-site or cross from the North Tract (portion of site north of Banshee Road) to the South Tract (portion of site south of Banshee Road) or vice versa. The data collected in the RFI were used in the subsequent risk assessments.

On December 22, 2004, MDNR approved the *RFI* (MACTEC, 2004b). Refer Appendix A.

1.2.2 Risk Assessments

Subsequent to the approval of the RFI, two risk assessments were performed and these including addenda are referred to collectively in the CMS as the “risk assessments”:

- *Risk-Based Corrective Action Report, Boeing Tract 1, St. Louis, Missouri* (RAM, 2004), including nine addenda (RAM Group, 2009c-i,k,l).
- *Final Risk Assessment, Boeing Tract 1 Facility, St. Louis, Missouri* (Tetra Tech, 2008), prepared for the USEPA.

On March 16, 2009, the MDNR issued a letter of *Outstanding Comment on Boeing Resource Conservation and Recovery Act Risk-Based Corrective Action (RBCA) Report Dated September 2004, Hazelwood, Missouri, EPA ID# MOD000818963* (MDNR, 2009a). In response to General Comments from the MDNR, nine addenda were prepared and subsequently approved by the agencies in a letter dated August 24, 2009 (MDNR, 2009b). Refer to Appendix A.

1.2.2.1 RAM Risk Assessment

The risk assessment prepared by RAM (2004) divided the facility into nine Areas and a total of 23 Sub-areas, each characterized by similarities in factors that affect human health under current and reasonable future land use conditions. These areas are shown in Figure 1-1 and details summarized in Table 1-1. Additional details are included in Appendix B. The receptors, pathways, complete routes of exposure for current and future land use, and available soil and groundwater data were identified for each Area/Sub-area.

The large number of constituents analyzed in soil and groundwater were screened to identify the COCs for which quantitative risks were calculated. The cumulative risk for each receptor in each Area/Sub-area was calculated. Further, the risk assessment prepared by RAM included an evaluation of the potential impacts to Cold Water Creek and concluded the absence of ecological risks.

RAM Group recalculated the representative soil concentrations and risks for Sub-area 2B by excluding the soil concentrations for samples that were removed during excavations. As expected, the representative soil concentrations decreased and some increased. Although, the calculated risks are different, there is no change in the overall risk management decision.

Based on comments received from the MDNR (MDNR, 2009a), and with the agencies' concurrence, RAM Group subsequently prepared nine addenda to address these comments. These addenda, considered a part of the approved risk assessment prepared by RAM, dealt with the following issues:

1. Changes in toxicity values for certain chemicals and their effect on the calculated risks (RAM Group, 2009c);
2. Changes in exposure factors and their effect on the risks (RAM Group, 2009d);
3. Effect of changes in both toxicity values and exposure factors on risks (RAM Group, 2009l);

4. The use of laboratory qualified data in risk assessment (RAM Group, 2009e);
5. Chemicals with maximum detected concentrations greater than 10 times representative concentrations (RAM Group, 2009f);
6. Protection of surface water (RAM Group, 2009h);
7. Uncertainty analysis in the risk assessment (RAM Group, 2009i);
8. Sensitivity analysis for buildings with and without basements (RAM Group, 2009k); and
9. Errata to correct typos and errors in the risk assessment (RAM Group, 2009g).

The approved risk assessment prepared by RAM indicated that the cumulative risks were below the MDNR and USEPA target risk levels for all scenarios except for the following receptors and areas (prior to the revision of TPH risk calculations described in Section 1.2.2.3 below):

- Non-residential worker – Sub-areas 2A, 2B, 3A, 3C, 3E, 3G, 6B, 6C, and 8B; and
- Construction worker – Sub-areas 2B and 2C.

1.2.2.2 Tetra Tech Risk Assessment

As part of USEPA's independent review of the risk assessment prepared by RAM that generally followed the Missouri Risk-Based Corrective Action (MRBCA) process, the USEPA asked Tetra Tech to perform a risk assessment of selected areas using the USEPA Risk Assessment Guidance for Superfund (RAGS) protocols. The intent was to compare the results obtained using the two risk assessment approaches. The risk assessment prepared by Tetra Tech focused on Sub-areas 2C, 3F, 3H, and 6B.

The results indicated that generally the two risk assessment approaches resulted in similar risk management decisions. Additionally, risks were exceeded for the future construction worker due to groundwater impacts in Sub-areas 2C (outdoor inhalation), 3H (outdoor inhalation), and 6B (outdoor inhalation and dermal contact). Tetra Tech also indicated in the Executive Summary of their risk assessment report that risk due to arsenic was exceeded for the outdoor worker as a non-carcinogenic hazard in Subarea 6B soil; however, their risk calculation Table A-9.2 did not indicate an exceedance for arsenic (Tetra Tech, 2008). Thus, the comment in the executive summary was not supported by their results presented in the table and hence was an oversight.

1.2.2.3 Issue Related to TPH Risk Calculations

During the preparation of the CMS Work Plan, errors in the calculation of risk for TPH were identified. Specifically, concentrations that exceeded the solubility and saturated vapor concentrations had been erroneously used in the calculation of risks. With the agencies' concurrence, RAM Group re-calculated the risk due to TPH using the solubility and saturated vapor concentrations for indoor and outdoor inhalation pathways. The revised risks were

documented in the following four memoranda and submitted to the MDNR in November 2010:

1. Risk evaluation of TPH for indoor inhalation pathway (RAM Group, 2010a);
2. TPH risk for outdoor inhalation of vapors from groundwater by future construction worker in Sub-area 3C (RAM Group, 2010h);
3. Risk evaluation for outdoor inhalation of vapors from groundwater by outdoor worker in Sub-areas 2C and 6B (RAM Group, 2010i); and
4. Risk evaluation for outdoor inhalation of vapors from groundwater by future construction worker in Sub-areas 2C, 3H, and 6B (RAM Group, 2010j).

These memoranda concluded that several of the previously calculated risk exceedances due to TPH were in error and the corrected risks were in fact acceptable.

1.2.2.4 Summary of Risk Evaluations

Following are the conclusions based on the two risk assessments and the above mentioned thirteen memoranda:

- The calculated risk levels were within MDNR and USEPA-specified guidelines for all scenarios, except the potential future construction worker in Sub-areas 2B, 2C, 3H, and 6B. None of the other areas or sub-areas had any risk exceedances. Further, none of the other receptors considered, specifically current or future commercial worker, had any risk exceedance. The risk assessment prepared by RAM indicated the following risk exceedances for the future construction worker:
 - Sub-area 2B – Dermal contact with groundwater by tetrachloroethene (PCE); and
 - Sub-area 6B – Dermal contact with groundwater by benzo(a)anthracene.
- The risk assessment prepared by Tetra Tech indicated the following risk exceedances for the future construction worker:
 - Sub-area 2C – Outdoor inhalation from groundwater by benzene and TPH-gasoline range organics (TPH-GRO);
 - Sub-area 3H – Outdoor inhalation from groundwater by mercury and TPH-diesel range organics (TPH-DRO);
 - Sub-area 6B – Dermal contact with groundwater by trichloroethene (TCE) and Aroclor 1254; and
 - Sub-area 6B – Outdoor inhalation from groundwater by benzene, total 1,2-dichloroethene (DCE), mercury, TCE, vinyl chloride, TPH-GRO, and TPH-DRO.

The above results are summarized in Table 1-2.

1.2.3 Interim Remedial Actions

Prior to, during, and after the RFI and risk assessments, interim remedial measures were conducted as discussed below.

1.2.3.1 Pre-RFI Interim Remedial Actions

Interim Corrective Action Measures were performed at four SWMUs from October 10, 1997 to November 11, 1997. The SWMUs were identified as:

- SWMU #10 (Waste Oil Tank located at Building 5),
- SWMU #22 (Paint Booth Satellite Accumulation Area located at Building 2),
- SWMU #26 (former Less-Than-90-Day Storage Area located near former Building 40), and
- SWMU #28 (Electrical Power Transformer located near Building 5). These actions were described in the RFI (MACTEC, 2004b) and the *Measures Completion Report* (Heritage, 1997) and are summarized below.

SWMU #10 (Risk Area 4): SWMU #10 consisted of a 375-gallon capacity AST used to containerize compressor oil (waste oil) that was recovered from condensate from an oil-lubricated steam-driven air compressor. On November 12, 1997, the AST was decommissioned, the area was cleaned, and a 275-gallon steel AST was installed at a location interior to Building 5 within a polyethylene secondary containment unit.

SWMU #22 (Risk Sub-area 3D): SWMU #22 consisted of a satellite accumulation area for wastes generated from painting operations performed at Building #2. Interim measure activities at this SWMU included the placement of a 1-inch lift of asphalt surface cover material to effectively seal existing cracks in the former surface grade. The surface area covered by the resealing activities measured 25feet by 25feet (625 square feet).

Investigation of the abandoned sump on October 3, 1997, identified the sump to be a former storm-water drain trap that measured about 48-inches by 30-inches. The base of the sump was 51-inches below surface grade. Upon removal of the wood-timber surface cover, the sump had approximately 19-inches of standing water overlaying approximately 21-inches of liquid sludge. Water and sludge were removed from the sump utilizing a drum vacuum and suction hose. Removed sludge was containerized in a steel 55-gallon drum. The sump was final washed utilizing a low pressure Citra Clean and water solution wash followed by a high-pressure water rinse. After completion of the cleaning activities at the sump, the sump cavity was backfilled with 1-inch clean stone to 6-inches below surface grade. The sump was sealed at surface grade utilizing a 6-inch poured-concrete pad.

SWMU #26 (Risk Area 1): The former SWMU #26 consisted of a former Less-Than-90-Day Storage Area for drummed waste solvents, paints, and oils transported from Satellite

Accumulation Areas in Building #40. Specifically, SWMU #26 consisted of a small, prefabricated, corrugated steel constructed building with a raised steel grated floor. On October 10, 1997, cleaning and sealing activities were performed at the former SWMU #26.

SWMU #28 (Risk Area 4): The former SWMU #28 consisted of a former power transformer station located outside of the northeast corner of Building #6. On October 7, 1997, activities included the decommissioning and removal of the power transformer, cleaning of the concrete pad, and removal of impacted gravel and underlying soil as necessary to remove impacted soil. Soil underlying the gravel surface did not exhibit a visible indication of oil-impact and as a result, soil was not excavated. After completion of the removal activities, soil samples were collected for laboratory analysis of PCBs from the west and south-west perimeter of the concrete pad which exhibited the greatest potential for impact from transformer oil. The 0 to 12-inch composite sample detected 1.4 mg/kg PCBs. The two individual 12 to 18-inch samples had concentrations below the reporting limit of 0.2 mg/kg PCBs. Laboratory results from soil samples collected after the soil/gravel removal reported PCB concentrations below the method detection limits at the floor of the excavation (18 inches below surface grade).

1.2.3.2 Interim Remedial Actions During RFI

Several interim remedial actions were performed during the RFI activities. These are discussed in the RFI (MACTEC, 2004b) and are summarized below.

Industrial Sewer (Risk Sub-area 6C): Two industrial wastewater sewer lines run underneath the parking lot east of Building 27. These sewers provided drainage from the plating and aluminum lines in Building 27 to the Boeing Industrial Wastewater Treatment Plant (WWTP). Following the Fabrications Operations Environmental Investigation in July 2000 (ESE, 2000), the industrial sewers were internally inspected in October 2000 using a video camera and were found to be constructed of cast iron with a notable separation at a specific joint in the vicinity of boring B27E4. The sewer lines from Building 27 to the first junction manhole were replaced in November 2000 and approximately 75 cyd of impacted soil in proximity to the sewer lines were excavated and disposed of as "special waste."

Enhanced Bioremediation Pilot Test (Risk Sub-area 6B): A pilot test was implemented in June 2002 at the scrap metal recycle dock. The pilot test consisted of the injection of 810 lbs of HRC in nine soil borings placed around monitoring well MW3. Groundwater sampling was performed to monitor the results in this well and two wells installed approximately 25 feet (ft) upgradient (MW3A) and downgradient (MW3B) of MW3. According to the RFI, the results of the pilot test provided definitive evidence that reductive dechlorination was occurring within the test area and that the injection of HRC accelerated the rate of chlorinated compound degradation. The dechlorination process was observed to go to completion with the reduction of TCE → cis-DCE → vinyl chloride → ethene → ethane (MACTEC, 2004a and 2004b). However, current conditions indicate elevated concentrations of cis-1,2-DCE and vinyl chloride; thus, the HRC injection did not address the full extent of chlorinated solvents in this area.

1.2.3.3 Post-RFI Interim Remedial Actions

Interim Action Remedial Excavation (Risk Sub-areas 3A, 3E, 6B, and 8B): Impacted soil was excavated in 2005 and disposed off-site (MACTEC, 2006a). The objective was to remove impacted soil that could be a source for groundwater impacts. The following table summarizes the dimensions of the excavated areas and the amount of soil removed.

Sub-area	Date of Excavation	Dimension of Excavate Area	Mass of Soil Excavated (tons)
Sub-area 3A	October 27, 2005	11.5 ft × 9.5 ft × 8 ft depth	88.23
Sub-area 3E	October 27, 2005	7 ft × 8 ft × 4 ft depth	8.12
Sub-area 6B	September 8, 2005	15 ft × 15 ft × 6 ft depth	56.32
Sub-area 8B	September 7, 2005	10 ft × 10 ft × 5 ft depth	23.02

Piezometers were installed in each interim action area and groundwater samples were collected and analyzed once prior to and twice after completing the interim action excavations.

Soil confirmation samples were collected from the limits of the excavations and were analyzed in the laboratory. Tables 1-3(a) to (d) summarize the results for the detected chemicals.

Interim Measures, Solid Waste Management Unit 17 (Risk Sub-area 2B): Impacted soil was excavated and disposed off-site (MACTEC, 2006b). The objective was to remove impacted soil that could be a source for shallow groundwater impacts. Eight thousand lbs of HRC was added to the floor of the excavation to enhance the in-situ biodegradation of chlorinated solvents. The following table summarizes the dimension of the excavated area and the amount of soil removed.

Sub-area	Date of Excavation	Dimension of Excavated Area	Mass of Soil Excavated (tons)
Sub-area 2B	November 8 – 16, 2005	20 ft × 20 ft × 10 ft depth	2,073.15 105.1 hazardous waste

Groundwater samples were collected and analyzed from nearby piezometers and monitoring wells prior to the interim action excavation and the summary of results is shown in Table 1-4.

Three piezometers and a monitoring well (TP-1, TP-2, B5111, and MW-7S) were removed during the excavation and were not replaced. A 4-inch diameter stainless steel well screen was placed in the southeast corner of the excavation to a depth of 10 ft to act as a backfill observation well (SWMU17-OB-1). No post-excavation groundwater sampling was performed as part of the interim action measure.

RAM Group compared and evaluated the groundwater data collected prior to and after the interim action (Boeing, 2010a). The results of the evaluation indicate that bio-attenuation of solvents is active within the excavated area and downgradient of the excavation.

Active anaerobic biodegradation of chlorinated solvents has been documented in Sub-area 2B in 2001. The evidence is based on analytical results and field measurements of biodegradation parameters in monitoring wells MW-5I and MW-9S (Harding ESE, 2002). Addition of HRC during interim action soil excavation in 2005 enhanced the biodegradation by reductive dechlorination which is evident from the comparison of groundwater data collected before the excavation (1998-2005) and the data collected after the excavation (2008-2010). In the source area, PCE concentrations decreased at SWMU17-OB-1 after the interim action with a corresponding increase in degradation products (1,2-DCE and vinyl chloride). Similar trend was observed at TP-4 (Boeing, 2010a). Although not clear, the degradation may have stalled at the vinyl chloride level. Also refer to Section 1.2.3.5 for the proposed interim remedial action for this area.

1.2.3.4 Interim Measures for LNAPL Recovery

LNAPL recovery has been performed using hand bailing and vacuum truck. The documentation for these activities is within the individual UST closure reports that were submitted to the MDNR. The RFI (MACTEC, 2004b) documented LNAPL recovery activities in Risk Area 1 and Sub-area 2C.

Risk Area 1: As part of investigation and remedial action conducted at the SWMU 14 area (also referred to as Site No. 4), 11 monitoring wells (MW-A5, MW-A14, MW-A15, MW-A22, MW-A23, MW-A24, MW-A25, MW-A26, MW-A27, MW-A28, MW-A29) were installed (ATEC, 1990, Riedel, 1990). LNAPL was observed in six of these 11 wells immediately after their installation in 1989. LNAPL recovery consisting of vacuum removal of liquids from selected wells with a vacuum truck was conducted monthly from 1990 through 1998. Vacuum removal was performed weekly from 1992 to 1994, then changed to monthly for some wells and annually for others.

In Risk Area 1, following the initial investigation of UST Site No. 3 in Area 1, Boeing subsequently began conducting periodic groundwater remediation/monitoring efforts in 1990. Two additional monitoring wells (B45CMW-3A and B45CMW-3B) were installed in 1995. LNAPL recovery and groundwater remedial action consisting of vacuum removal of water from selected wells in the area with a vacuum truck was conducted on a monthly basis from 1990 through February 2002. Vacuum removal was performed weekly from 1992 to 1994, then changed to monthly for some wells and annually for others. LNAPL was discovered in MW-A1 and B45CMW-3A in June 2003. These wells were hand bailed twice per month until September 2003.

Risk Sub-area 2C: As part of investigation and remedial action conducted in the vicinity of a piping failure (referred to as Site No. 1), six monitoring wells (MW-A9, MW-A10, MW-A11, MW-A12, MW-A13, and MW-A20) were installed (ATEC, 1990, Riedel, 1990). LNAPL was observed in four of these six wells immediately after installation in 1989. LNAPL recovery and groundwater remedial action consisting of vacuum removal of liquid from selected wells in the area with a vacuum truck was conducted on a monthly basis from 1990 through 1998.

1.2.3.5 Proposed Interim Remedial Action

Interim remedial actions have successfully addressed nearly all current and future risk exceedances except for the few remaining issues for which actions are evaluated in this CMS. Although not needed to address risk exceedances, supplemental remediation at two source areas in Sub-areas 2B and 6B are being considered as a proactive voluntary action to further reduce residual groundwater concentrations of chlorinated solvents and contaminant mass using a localized injection program. A work plan for the continuation of interim remedial actions consisting of in-situ chemical oxidation (ISCO) of chlorinated solvents and the associated monitoring in Subareas 2B and 6B, was proposed to MDNR on December 6, 2011 (RAM Group, 2011b). This work will be initiated upon agency approval of the work plan. The proposed effort is effectively a continuation of the previously implemented interim remediation measures in these two areas.

1.2.3.6 Summary of Interim Remedial Actions

As discussed above, several interim remedial actions have been completed at this site. These include AST, UST, and transformer removals, industrial wastewater sewer line replacement, soil excavation and disposal, surface cleaning and sealing of waste storage areas, enhanced bioremediation pilot test, HRC injection for on-site treatment of soil and groundwater, and LNAPL removal. These actions have removed and controlled several of the source areas at the site and have provided evidence of biodegradation; thus, the stage has been set to continue remedial processes using MNA to address the remaining residual impacts.

1.2.4 Groundwater Sampling

Since the approval of the RFI, groundwater sampling has been performed in November 2008, April 2010, November 2010, and July 2011 per the MDNR approved sampling plan. The results of these events have been submitted to the MDNR and USEPA (RAM Group, 2009a,b,j, 2010f,k, 2011a). The results of gauging activities are summarized below:

Sampling Event	No. of Wells Gauged				Average Groundwater Depth (ft bgs)		
	B	S	I	D	S	I	D
November 2008	1	48	3	5	5.6	7.3	12.9
April 2010	1	48	3	5	5.5	7.0	9.4
November 2010	1	53	3	6	5.7	8.6	8.9
July 2011	1	39	3	4	4.85	7.04	10.11

Notes:

B: Backfill zone
I: Intermediate zone

D: Deep zone
S: Shallow zone

ft bgs: Feet below ground surface

The average horizontal groundwater flow gradients were to the east at 0.01 ft/ft for the shallow zone and to the south and southeast at 0.009 ft/ft in the deep zone. The groundwater samples were analyzed for several analytes and the data collected are presented in the groundwater monitoring reports (RAM 2009a, 2010f and k, 2011).

1.2.5 Abandonment of Monitoring Wells

Seven wells were abandoned on March 7-8, 2011 per MDNR approval (MDNR, 2010c), because they could not be gauged or sampled due to severely damaged wells, artesian conditions, or the wells required significant maintenance or repair. The abandoned wells were located in Area 1 (B45CMW-3A, B45CMW-3B, and MW-A15), Sub-area 2A (MW-A16 and MW-A7), Sub-area 6B (MW9D), and Sub-area 6C (B25MW4).

1.3 CURRENT SITE CONDITIONS

This section discusses the current site conditions related to (i) the site, (ii) LNAPL, and (iii) dissolved phase concentrations.

1.3.1 Site Description

As presented in Section 1.1, the site included several buildings used to service and manufacture aircraft, office buildings, parking lots, a coal fueled power plant, and a wastewater treatment facility. Several of these buildings have been demolished. Table 1-5 lists the remaining buildings at the site and Figure 1-1 shows the locations of these buildings.

Based on an investigation in 1995, 32 SWMUs were identified. All except SWMUs #3 and #21 associated with Boeing's active WWTP, have been closed or are no longer in use (refer to Table 1-6). The site included several USTs, above ground storage tanks (ASTs), and other waste handling areas. Of the 68 USTs, one (B40) is still active (refer to Table 1-7). B40 is an open top tank used to contain wastewater treatment sludge. Since 1952, Boeing has conducted numerous site investigations and remedial actions at the site.

1.3.2 Permit Modification

The following three areas were identified to be removed from the RCRA Permit:

- Area 1 – Runway Protection Zone;
- Area 7 – Engineering Campus; and
- Area 8 – Office Complex North.

These areas were recommended for removal from the permit in the November 23, 2011 memorandum (refer to Appendix C) based on one or a combination of the following factors:

1. Absence of ongoing manufacturing activities involving storage, disposal or treatment of waste;
2. Absence of SWMUs;
3. Absence of any current USTs;
4. Absence of contamination based on the environmental activities conducted at the site including RFI, risk assessments, interim measures, and monitoring activities;
5. Acceptable risk for current and reasonable future receptors; and
6. No need for any further corrective actions.

The following text describes each of the three areas and reasons for recommending removal from the permit.

Area 1 – Runway Protection Zone: The Runway Protection Zone is located in the southern portion of the site, adjacent to the current runway and covers an area approximately 1,500 ft long by 600 ft wide. Within Area 1, there were 23 buildings or structures, in addition to portions of two buildings, and a small parking lot. All buildings within Area 1 were demolished and Area 1 has been designated as a Runway Protection Zone. As per FAA regulations, no buildings can be built in a runway protection zone. Area 1 is currently paved. Additional details of this area are included in Appendix C.

This area is petitioned for removal from the permit due to absence of any manufacturing activities, absence of current USTs, absence of any significant human activities in this area and no need for any further remedial activities.

Area 7 - Engineering Campus: The Engineering Campus is located in the northern portion of the site, bounded by Lindbergh Boulevard to the west and James S. McDonnell Boulevard to the north. Area 7 is owned by Boeing. No SWMUs were located within this area. There were six underground fuel storage tanks that were removed via excavation in 1989. During tank removal, no soil sampling activities were conducted due to the absence of any visual impacts. Subsequent to the removal of these tanks, as part of utility repairs and utility work, PID measurements were taken at these areas. Concentrations were always below 5 ppm. One soil boring that was converted to a groundwater well (MW2) is located in this area. Soil and groundwater samples have been analyzed for a comprehensive list of 67 and over 100 analytes, respectively. The few chemicals detected were not site related. Additional details of Area 7 are included in Appendix C.

This area is being petitioned for removal from the permit due to the absence of manufacturing activities, SWMUs, and absence of any contamination related to the site activities.

Area 8 – Office Complex North: The Office Complex North is located to the north of James S. McDonnell Boulevard and covers an area approximately 800 ft wide by 1,000 ft long. Within Area 8 are two buildings (220 and 221) separated by a small parking lot. No SWMUs were located in this area. An aboveground TCE degreaser with concrete containment was located in Building 220. The degreaser was removed in 1998. A trash compactor with a hydraulic oil system was located outside Building 220. Finally, a fuel oil UST was located near Building 221 that was removed in 1990 by excavation and confirmatory soil samples collected. In 2005, as a part of the interim corrective measures, 14 cubic meters of soil was excavated, removed, and disposed offsite. Additional details are provided in Appendix C.

This area is petitioned for removal from the permit due to absence of SWMUs, absence of site related COCs after interim remedial activities, and no need for any further remedial activities.

1.3.3 Light Non-Aqueous Phase Liquid

Historically, measurable LNAPL or sheen has been observed in Areas 1, 2, 3, and 6. Several interim remedial measures to remove LNAPL have been conducted as discussed in Section 1.2.3.4. Several separate LNAPL recovery events have been conducted in these areas from 1990 to 2003. As a result, the quantity of detected LNAPL and frequency of detections have dropped significantly; LNAPL is no longer detected in most of the former LNAPL recovery wells. LNAPL has only been detected in 14 wells since 2008 and these detections have been sporadic and at small thicknesses. The maximum thickness measured in any well has been less than 0.1 foot. Further, the residual LNAPL is weathered based on the absence of BTEX and other “small molecule” hydrocarbons. For additional details refer to Section 4.0.

1.3.4 Dissolved Concentrations

The dissolved concentrations at the site consist of several small mostly localized plumes, rather than one site-wide plume. Each identified risk area/sub-area had one or more different sources, and thus potentially different COCs.

Table 1-8 lists the wells that are currently present and can be sampled and well locations are shown in Figure 1-2. The groundwater data collected during November 2008, April 2010, November 2010, and July 2011 sampling events were evaluated by comparing the detected concentrations with available DWSs; however the site groundwater is not currently used for drinking water purposes and will not be used in the future. The DWSs were selected based on the following hierarchy:

- MCLs,
- Regional Screening Levels, and
- MRBCA default target levels.

DWSs were selected for comparison as a general way to define the current condition of groundwater quality. The result of the comparison identified 19 chemicals (including 14 VOCs, 2 total petroleum hydrocarbons [TPHs], and 3 metals) in 12 areas/sub-areas that exceeded the DWSs. Several of these exceedances were considered outliers due to sporadic concentrations, laboratory issues, and background concentrations. The evaluation of these exceedances is discussed in Appendix D which identified 12 selected chemicals of concern (SCOCs) that are site related in four areas/sub-areas after the outliers had been eliminated. This evaluation is generally consistent with the historic data. The following table lists the chemicals and the areas where the groundwater concentrations exceeded the DWS.

SCOCs	SV (µg/L)	Source	Area 1	Sub-area 2B	Sub-area 6B	Sub-area 6C
Hexavalent chromium	0.04	RSL				X
1,1,2-Trichloroethane	5	MCL		X		
1,1-Dichloroethane	2.4	RSL			X	
1,1-Dichloroethylene	7	MCL		X	X	
1,2-Dibromomethane	0.05	MCL	X			
Benzene	5	MCL			X	
cis-1,2-Dichloroethylene	70	MCL		X	X	
Naphthalene	0.14	RSL	X	X		
PCE	5	MCL		X	X	
trans-1,2-Dichloroethylene	100	MCL			X	
TCE	5	MCL		X	X	
Vinyl chloride	2	MCL		X	X	

X: SCOCs- selected chemicals of concern

RSL: Regional screening level (USEPA, June 2011)

SV: Screening Value

µg/L: micrograms per liter

Note in Area 1, the runaway protection area, no buildings can be built. Therefore, the SCOCs are only applicable for the groundwater protection pathway.

As discussed in Section 1.2.3.5, Sub-areas 2B and 6B are subject of further interim remedial activities. The selected remedy for the groundwater impacts is presented in Section 5.0.

SECTION 2.0

AREAS AND ISSUES INCLUDED IN THE FOCUSED CMS

This section presents the specific issues that are addressed in this focused CMS. As discussed in the previous section, extensive activities to date have allowed source areas to be identified, past interim remedial actions have addressed soil and groundwater impacts in nearly all areas, and the corrective measures study has indicated only a few remaining issues. The remaining issues have been identified based on the various activities conducted at the site, the current site conditions (refer to Section 1.3), the approved CMS Work Plan, and the various discussions with the agencies since submission of the work plan. Specifically, the four issues include:

- Issue No. 1: Sub-areas with risk exceedances;
- Issue No. 2: Light non-aqueous phase liquid (LNAPL) in certain wells;
- Issue No. 3: Exceedance of DWS in groundwater; and
- Issue No. 4: Confirmation that future risk from complete exposure pathways associated with groundwater will not exceed regulatory acceptable risks; i.e., confirmation that the groundwater concentrations are stable/declining.

Details of each of the issues are discussed below.

2.1 SUB-AREAS WITH RISK EXCEEDANCES

The risk assessments (RAM, 2004 and Tetra Tech, 2008) did not find risk exceedances related to soil concentrations to any receptor or any pathway. The only risk exceedances were for exposure pathways associated with groundwater.

Consistent with the CMS Work Plan, the risks included in the risk assessment prepared by RAM (2004) have been re-calculated. These re-calculations are consistent with the methodologies approved for this site. Specifically, the re-calculated risks include the combined effects of (i) changes in the quantitative toxicity values, (ii) changes in exposure factors, (iii) use of TPH solubility concentrations for representative concentrations that exceeded solubility limits, (iv) use of TPH saturated vapor concentrations for representative concentrations that exceeded saturated vapor concentrations; and (v) change in soil representative concentrations due to the result of 2005 interim actions. The recalculation of risks is presented in Appendix E. These risks differ from the risks presented in the technical memoranda referred to in Section 1.2.2.1 in that these risks include the combined effect of all the factors that changed. To ensure consistency with the approved risk assessment prepared by RAM, the representative groundwater concentrations were not revised based on the groundwater data collected during the 2008, 2010, and 2011 groundwater sampling events.

The re-calculated cumulative risks for each receptor in each area/sub-area are summarized on Table 2-1. The effect of these calculations on the focused CMS is discussed below.

2.1.1 Areas Requiring Further Evaluation

Table 1-1 presents a description of all the risk assessment exposure areas. Refer to Figure 1-1 for the location of these areas/sub-areas. Figure 2-1 and Table 1-2 presents the four sub-areas with risk exceedances based on the updated results of the risk assessments prepared by RAM and Tetra Tech. These four sub-areas and the specific exposure pathways that cause the risk exceedances require risk management. The remaining 19 areas/sub-areas do not have any risk exceedances. Thus, with respect to Issue No. 1, related to risk exceedances, the following four sub-areas and receptors will be considered further in the focused CMS. The selected remedy for this issue is discussed in Section 3.0.

2.1.1.1 Future Construction Worker: Outdoor Inhalation of Vapors from Groundwater

Groundwater concentrations in the following three sub-areas caused risk exceedances to the future construction worker due to outdoor inhalation of vapors:

- Sub-area 2C Benzene and TPH-GRO;
- Sub-area 3H Mercury and TPH-DRO; and
- Sub-area 6B Benzene, mercury, 1,2-DCE (total), TCE, vinyl chloride, TPH-GRO, and TPH-DRO.

2.1.1.2 Future Construction Worker: Dermal Contact with Groundwater

Groundwater concentrations in the following two sub-areas caused risk exceedances to the future construction worker due to dermal contact with groundwater:

- Sub-area 2B PCE; and
- Sub-area 6B Benzo(a)anthracene, TCE, and Aroclor 1254.

2.1.2 Risk to Surface Water or Ecological Receptors

The approved risk assessment prepared by RAM concluded that there were no current or potential future surface water impacts to Cold Water Creek (RAM Group, 2009h) and no unacceptable risks to ecological receptors were identified in the risk assessment (RAM, 2004).

2.2 PRESENCE OF LNAPL IN CERTAIN WELLS

As a result of extensive LNAPL removal activities conducted at the site from 1990 to 2003, detections of LNAPL have declined to just a few wells. Since 2008, LNAPL has only been detected in 14 wells, and these detections have been sporadic. Most wells had merely a sheen with six wells with a small measurable thickness. The maximum thickness in any well since 2008 was 0.1 foot. Figure 2-2 identifies the location of wells with sporadic occurrences of LNAPL in Area 1 and Sub-areas 2A, 2B, 2C, and 3C since 2008. Proposed remedy for this issue is discussed in Section 4.0.

2.3 EXCEEDANCE OF DRINKING WATER STANDARDS

Regarding potable groundwater use at the site: 1) There is no current and no reasonable future probability of groundwater use; 2) Given #1, there are no exposures to groundwater as a potable water source; and 3) For comparison purposes, groundwater data collected during the four most recent monitoring events (2008, 2010, and 2011) indicate 12 chemicals exceed DWS or equivalent in four areas/sub-areas and the chemicals are potentially site related. The proposed remedy for this issue is further discussed in Section 5.0.

2.4 FUTURE RISK AND GROUNDWATER CONCENTRATION STABILITY

The future land use will remain non-residential. Thus, the exposure pathways evaluated in the approved risk assessments will remain the same. Therefore, risks can increase if the representative groundwater or soil concentrations were to increase.

To confirm that future risk associated with groundwater impacts does not increase, it is necessary to demonstrate groundwater stability; i.e., decreasing or stable concentrations of chemicals in groundwater. This condition will ensure that future risks will be less than or equal to the current risks, and hence below MDNR-specified criteria.

To assess groundwater stability, groundwater monitoring will continue until it can be confirmed that the groundwater concentrations are stable/declining and meet the prevailing MDNR criteria for stable concentrations. This issue is discussed in Section 6.0.

2.5 SUMMARY OF AREAS AND ISSUES

Table 2-2 summarizes the specific areas and sub-areas, which have one or more of the four issues discussed in this focused CMS.

SECTION 3.0 RISK EXCEEDANCES

This section discusses risk exceedances associated with groundwater presented in Section 2.0. The risk assessments indicated that the cumulative risks were within regulatory acceptable levels for all scenarios except for the construction worker for the following exposure pathways and areas: (i) potential dermal contact with groundwater in Sub-areas 2B and 6B, and (ii) outdoor inhalation of vapors from groundwater in Sub-areas 2C, 3H, and 6B. The four sub-areas with risk exceedances are shown in Figure 2-1. The remaining 19 areas/sub-areas do not have any risk exceedances and are not discussed further. There are no risk exceedances related to soil concentrations.

This section discusses the recommended actions to manage these risk exceedances.

3.1 FUTURE CONSTRUCTION WORKER EXPOSURES BY DERMAL CONTACT WITH GROUNDWATER

Groundwater concentrations in two sub-areas caused risk exceedances to the future construction worker by dermal contact with groundwater. These sub-areas and the chemicals that caused the risk exceedance are:

- Sub-area 2B PCE; and
- Sub-area 6B Benzo(a)anthracene, Aroclor 1254, and TCE.

3.1.1 Sub-area 2B/PCE

Carcinogenic Risk: For the construction worker in this sub-area, the cumulative individual excess lifetime cancer risk (IELCR) was 3.4×10^{-4} . The primary contributor to this cumulative IELCR is PCE with an IELCR of 3.3×10^{-4} due to dermal contact with groundwater (refer to Table 3B-12(b) in Appendix E).

Non-carcinogenic Risk: For the construction worker in this sub-area, the cumulative hazard index (HI) was 4.6. The primary contributor to this cumulative HI is PCE with a hazard quotient (HQ) of 4.3 due to dermal contact with groundwater (refer to Table 3B-12(b) in Appendix E).

PCE Target Concentration: The carcinogenic and non-carcinogenic risks were calculated using PCE representative concentration (RC) of 19,115 µg/L based on the concentrations from several monitoring wells in this sub-area prior to 2004. Groundwater RCs were calculated to achieve the regulatory acceptable risk below the target cumulative IELCR of 1×10^{-4} and the target cumulative HI of 1.0. As per the calculations presented in Appendix F, the groundwater RC of PCE should be below 4,183 µg/L to be protective of the construction worker. This concentration is referred to as the calculated target concentration (TC). Note that these calculated TCs are only to address the specific issue of unacceptable risk and are not considered a target or screening value for discontinuation of groundwater monitoring or for the other three issues.

3.1.2 Sub-area 6B/Benzo(a)anthracene

For the construction worker in this sub-area, the cumulative IELCR was 5.1×10^{-5} , which is below the target cumulative IELCR of 1×10^{-4} . However, the total IELCR of benzo(a)anthracene was 5.0×10^{-5} , which is above the target total IELCR of 1×10^{-5} . The primary contributor to this total IELCR is dermal contact with groundwater (refer to Table 7B-10(b) in Appendix E). This risk was calculated using benzo(a)anthracene RC of 126 µg/L based on the concentrations detected once in one well (RC2) in July 2000. Ten concentrations measured in six other near-by wells were reported below the laboratory reporting limit. To reduce risk from this pathway below the target total IELCR of 1×10^{-5} , the groundwater RC of benzo(a)anthracene should be below 26 µg/L, the calculated TC (refer to Appendix F).

RC2 was destroyed during soil excavation as part of interim actions completed in 2005. In recent sampling events in 2008 and 2010, 13 samples from 8 wells including RC14 located in close proximity to the former location of RC2 yielded concentrations below the calculated TC. For this reason, benzo(a)anthracene is no longer considered as causing an ongoing risk for the future construction worker.

3.1.3 Sub-area 6B/Aroclor 1254

For the construction worker in this sub-area, the cumulative IELCR was 6×10^{-4} (Table 7 in Tetra Tech, 2008). The primary contributor to this cumulative IELCR is Aroclor 1254 with an IELCR of 5.3×10^{-4} for dermal contact with groundwater. This risk was calculated using exposure point concentration (EPC) of 580 µg/L based on the maximum detected concentrations of two detected concentrations (one each in two wells, RC1 and RC2) in July 2000. Twelve concentrations in 11 other monitoring wells were reported below the reporting limit. Groundwater RCs were calculated to achieve the regulatory acceptable IELCR of 1×10^{-4} . These calculations are shown in Appendix F and result in a TC of 64 µg/L for Aroclor 1254.

RC1 could not be located during well search in 2008 and RC2 was destroyed in 2005 as noted above. There are no active wells near the location of RC1. In recent sampling events in 2008 and 2010, nine samples from six wells including RC14 located in close proximity to the former location of RC2 yielded concentrations that were below the calculated TC. For this reason, Aroclor 1254 is no longer considered as causing an ongoing risk for the future construction work pathway.

3.1.4 Sub-area 6B/TCE

For the construction worker in this sub-area, the cumulative HI was 880 (Table 7 in Tetra Tech, 2008). The majority contributor to this cumulative HI was due to outdoor inhalation of vapors from groundwater, which is addressed in Section 3.2.

Of the remaining cumulative HI, TCE HQ of 1.6 was due to dermal contact with groundwater, which was calculated using an EPC of 1,400 µg/L based on the concentrations from several monitoring wells in this sub-area prior to 2004. Groundwater RCs were calculated to achieve the regulatory acceptable target HI of 1.0. These calculations shown in Appendix F indicate the

groundwater TC for TCE of 13 µg/L.

3.2 FUTURE CONSTRUCTION WORKER EXPOSURES BY OUTDOOR INHALATION OF VAPORS FROM GROUNDWATER

Groundwater concentrations in the following three sub-areas caused risk exceedances to the future construction worker due to outdoor inhalation of vapors:

- Sub-area 2C Benzene and TPH-GRO;
- Sub-area 3H Mercury and TPH-DRO; and
- Sub-area 6B Benzene, mercury, 1,2-DCE (total), TCE, vinyl chloride, TPH-GRO, and TPH-DRO.

Per the risk assessment prepared by Tetra Tech, the risks for outdoor inhalation of vapors from groundwater to the construction worker were estimated using a trench model as discussed in the *Voluntary Remediation Program Risk Assessment Guidance* (Virginia Department of Environmental Quality (VDEQ)) with the following assumptions:

- Trench dimension of 8 ft length, 3 ft width, and 8 ft depth;
- Groundwater present in the trench at all times;
- Exposure duration of 1 year and exposure frequency of 125 days/year; and
- Exposure time of 4 hrs/day.

These assumptions are highly conservative and not deemed reasonable for the calculation of risk as discussed below.

The trench dimension assumed is small and it is highly unlikely that a construction worker will work continuously in such a trench for 4 hrs/day for 125 days. If a construction worker is working in a trench with larger dimensions, the volume of air mixed with the vapors emitting from groundwater on the trench floor will increase. This will reduce the air concentration in the trench, and hence the risk to construction worker will decrease. Therefore, the assumptions used to calculate risks overestimate the risks.

The trench model assumes the depth to groundwater is less than 8 ft below ground surface (bgs) resulting in standing water in the trench continuously for 125 days. This is unlikely since the trenches would typically be dewatered before and during major construction activities. The most likely and most frequent depth of construction will be in the 3 – 5 ft bgs range where the utilities are located. This is above the depth to water table; therefore, groundwater will not be encountered in most cases.

In addition, trench entry would require compliance with Occupational Safety and Health Administration (OSHA) requirements such as air monitoring prior to a construction worker entering the trench. If air monitoring revealed a potential hazardous situation, a construction worker would not work in the trench or would be required to wear protective gear. Further, construction activities involving subsurface excavation in the sub-areas with risk exceedances to the construction worker will require the use of a HASP, personal protective equipment (PPE),

and monitoring to protect the construction worker.

Air monitoring will be conducted in the work zone using instruments such as photoionization detector (PID) and appropriate respiratory protection will be provided to workers based on the PID levels. Specific PPE procedures, consistent with the requirements of this Section 3 and Section 9.1, will be discussed in the HASP prepared by contractors performing work in these areas including appropriate PPE to protect against dermal contact with groundwater for an extended period of time. As an added precaution, air monitoring will be conducted to ensure concentrations meet the OSHA permissible levels. In summary, based on the very conservative assumptions used to estimate the risks per the trench model; OSHA requirements; use of a HASP; use of appropriate PPE; and air monitoring; the future construction worker would not be exposed to unacceptable risks due to outdoor inhalation of vapors from groundwater.

3.3 PROPOSED REMEDY

Based on the above evaluation, the only receptor potentially with unacceptable risk is the future construction worker due to dermal contact with groundwater for PCE in Sub-area 2B and TCE in Sub-area 6B. The calculated TCs protective of this specific pathway and receptor are 4,183 µg/L and 13 µg/L for PCE and TCE, respectively.

Based on the groundwater monitoring conducted in 2010 and 2011, concentrations of PCE and TCE have exceeded the calculated TCs in the following monitoring points:

- Sub-area 2B/PCE MW-5I; and
- Sub-area 6B/TCE MW3, MW3A, and RC8D.

As discussed in Section 1.2.3.5, interim remedial measures have been proposed in these sub-areas. Such measures will further reduce the residual groundwater concentrations of PCE and TCE and contaminant mass in these sub-areas and will be confirmed by on-going monitoring. Risk will be managed through the use of AULs. Specifically, a HASP will be developed for all construction projects that require sub-surface excavation in Sub-areas 2B and 6B if dermal contact with groundwater is likely. The specifics of the HASP including the need for monitoring and PPE will be developed prior to initiating construction in these sub-areas.

Other criteria to be followed during soil excavation activities are described in the SMP; a copy is provided in Appendix G.

SECTION 4.0

PRESENCE OF LNAPL IN CERTAIN WELLS

4.1 OBJECTIVE AND BACKGROUND

This section discusses the past and current occurrence of LNAPL at the site and the remedy proposed to address this issue (Issue No. 2) consistent with state and federal regulations. Specifically, the code of Federal Regulation (40 CFR§280.64) requires owners to “*remove free product to the maximum extent practicable as determined by the implementing agency*”. However, the code does not define or expand upon the meaning of “to the maximum extent practicable”. At almost all sites, the definition is subject to interpretation depending on site-specific conditions and objectives.

The proposed remedial objectives for LNAPL removal are driven by (i) human or environmental risk reduction, (ii) mass reduction, or (iii) a combination of risk and mass reduction. The magnitude of human or environmental risk associated with LNAPL present at a site depends on the composition of the LNAPL, which affects adsorbed, dissolved, and vapor-phase hydrocarbon concentrations. Generally, as the LNAPL weathers, its volatility and solubility in water decreases since the lighter components preferentially biodegrade. Reduction in the mass of LNAPL, without a change in constituent composition, reduces the “longevity” of risk but not the magnitude of risk. The second objective of mass reduction is based solely on the removal of hydrocarbon mass as (i) LNAPL, (ii) dissolved, or (iii) vapor phase.

LNAPL exists as residual LNAPL, mobile LNAPL, or a combination. By definition, residual LNAPL does not migrate under hydraulic gradients (natural or forced) and is almost impractical to remove while mobile LNAPL can migrate under hydraulic gradients. Mobile LNAPL can accumulate in monitoring wells (assuming wells are properly constructed and developed) and is potentially recoverable (ITRC, 2009).

As a result of extensive LNAPL removal activities conducted from 1990 to 2003, LNAPL has only been detected in 14 wells since 2008 and these detections have been sporadic and at small thicknesses. The maximum thickness measured in any well has been less than 0.1 foot.

4.2 DATA EVALUATION

Figure 2-2 shows the location of all the wells with current and historic detection of LNAPL. Table 4-1 presents summary of all the available data related to LNAPL measurements and Table 4-2 presents the gauging data for the wells that had LNAPL since 2008. LNAPL has not been observed in Areas 4, 5, 7, 8, and 9. Thus the following discussion applies only to Areas 1, 2, 3, and 6.

The petroleum products used in Area 1 and 2 were jet fuels and gasoline which contain paraffins (primarily C6-C16) and aromatic compounds. Paraffins are typically not considered chemicals of concern (COCs) since their degradation rates are high, their toxicity and hence the associated human health risk is low. In fact, these chemicals are generally not included in the sampling and analysis plans for hydrocarbon impacted sites. Several aromatic constituents were measured as a part of the various ground water monitoring events in Areas 1, 2, 3, and 6.

4.2.1 Area 1 (Runway Protection Zone)

Historically, sixteen wells in Area 1 had LNAPL. Of these, five wells have indicated measurable LNAPL or sheen since 2008 (refer Table 4-2). The maximum LNAPL thickness observed in Area 1 since 2008 is 0.01 foot. During the June 2011 groundwater monitoring event, none of the wells in Area 1 had measurable LNAPL or sheen. As discussed in Section 1.2.3.4, interim remedial activities for LNAPL recovery and natural attenuation have contributed towards decrease in LNAPL levels. Since measurable LNAPL or sheen has not been observed in the most recent groundwater monitoring event, mobile LNAPL (potentially recoverable) does not exist in Area 1.

Groundwater samples were collected from below the LNAPL from four wells to determine whether the trace LNAPL was a continuing source of dissolved COCs. Specifically, samples were collected at MW-A1 and MW-A3 during the November 2008 event; MW-A27 during April-May 2010 event; and MW-A1, MW-A3, and MW-A25 during October-November 2010 event. These samples were analyzed for VOCs. The concentrations for chemicals detected in at least one sample are presented in Table 4-3, which shows six petroleum based aromatics and TPH were detected in at least one well. The detected chemicals are mostly "J"-qualified. BTEX and MTBE compounds, typically considered the risk drivers, were not detected in the groundwater.

Comparison of the detected concentrations with the corresponding groundwater screening values indicates that all concentrations were below the screening values. Conservatively, the screening levels used are MCLs or equivalent, despite the fact that the groundwater consumption pathway is not complete. Since all the detected petroleum based aromatic concentrations are below the screening values, LNAPL is not an ongoing source for dissolved COCs in groundwater in Area 1.

The USTs in Area 1 were closed per MDNR regulations and the closure letters received in 2002 are included in Appendix H (MDNR, 2002a and b). Therefore, there is no continuing source of petroleum hydrocarbons.

The following conclusions can be made based on the data and observations noted above:

- Absence of mobile LNAPL due to the interim remediation and natural attenuation;
- Residual LNAPL is not a source of dissolved hydrocarbons in the groundwater;
- The estimated risk is acceptable in Area 1 under current and future scenarios; and
- No further remedial activities are necessary to address residual LNAPL in Area 1.

4.2.2 Area 2 (Demolished Area)

Historically, fourteen wells in Area 2 had LNAPL of which eight wells had LNAPL since 2008 (Table 4-2). Of the fourteen wells, four wells were abandoned and MW-A19 was not gauged

since 2008, as the well location could not be confirmed. The maximum LNAPL thickness observed in Area 2 since 2008 is 0.1 foot. During the June 2011 monitoring event, only MW-9S and MW-10S had LNAPL with thicknesses of 0.03 and 0.06 ft, respectively. None of the other wells in the area had measurable LNAPL or sheen including MW-11S located 100 ft east of MW-10S. Sheen was observed at MW-A6 and MW-5I during gauging of April-May 2010 event, but was not observed during sampling two weeks later and also not observed during the November 2008, October/November 2010, and June 2011 sampling and gauging events. The LNAPL thickness in Area 2 is very small and sporadic, localized in a small area around MW-9S and MW-10S and the thickness fluctuates.

During November 2008, five wells had LNAPL and groundwater samples were collected from each of these wells. The concentration data for detected and "J"-qualified chemicals is presented in Table 4-4. Specifically, the detected benzene, xylene, and MTBE concentrations were below the respective screening values. TPH-DRO concentration at MW-9S and naphthalene concentration at TP-4 exceeded the respective screening values. These exceedances appear to be localized at the two wells since none of the other wells in Area 2 had exceedances for TPH-DRO and naphthalene. The average TPH-DRO concentration at MW-9S from the data collected until 2004 was 4,525 µg/L; hence, the concentration of 720,000 µg/L appears to be an anomaly. The average concentration of naphthalene at TP-4 until 2004 was 5.09 µg/L; whereas, the concentration in 2008 was 2.4 µg/L, which is an estimated concentration with "J"-qualifier. Therefore, naphthalene concentration appears to be decreasing and localized to this well. The above data indicates that the trace/residual LNAPL is not acting as a source of groundwater impact in Area 2.

The USTs in Area 2 were closed per MDNR regulations and the closure letters received in 2002 are included in Appendix H (MDNR, 2002c and d). Therefore, there is no continuing source of petroleum hydrocarbons.

The following conclusions can be made based on the observations noted above:

- Sporadic and trace levels of LNAPL thickness exist in two wells possibly due to the interim remediation and natural attenuation;
- Trace/residual LNAPL is not a source of dissolved hydrocarbons in the groundwater above screening levels;
- The estimated risk associated with petroleum hydrocarbons is acceptable in Area 2 under current and future scenarios; and
- No further remedial activities are necessary to address the trace LNAPL issue in Area 2.

4.2.3 Area 3 (Retained Area)

Sheen was observed at MW-A4 during gauging of April-May 2010 event, but was not present during sampling two weeks later. LNAPL was not observed at any other well in Area 3. No VOCs were detected at MW-A4. Therefore, LNAPL is not of concern in this area.

4.2.4 Area 6 (GKN Facility)

Sheen was observed at RC2 in July 2004. RC2 was destroyed during interim actions in 2005 and wells in close proximity to the former location of RC2 did not have LNAPL during recent groundwater monitoring events. None of the other wells in this area had LNAPL. Therefore, LNAPL is not of concern in this area.

4.3 PROPOSED REMEDY

Based on the above observations, the residual/trace LNAPL meets the remedial objectives for LNAPL (i.e., the risk is acceptable), the residual LNAPL is not an on-going source for dissolved groundwater impacts, and interim measures have removed LNAPL mass to the extent practicable.

Since the remedial and regulatory objectives related to LNAPL have been met, no remedy is necessary and hence none is proposed to address this issue.

SECTION 5.0

GROUNDWATER CHARACTERISTICS AND PROPOSED REMEDY

This section summarizes the hydrogeology, groundwater use, groundwater classification in accordance with USEPA guidance, and the proposed remedy for the areas with groundwater concentrations that exceed DWSs.

5.1 HYDROGEOLOGY

The stratigraphic units present at the site are shown in Figure 5-1 (modified after RFI Figure 2-12). This figure presents a comparison of the site stratigraphy to the adjacent FUSRAP SLAPS stratigraphic units. The SLAPS is located across Coldwater Creek to the east of Sub-area 6D. Fill and topsoil (SLAPS Unit 1) overlie the Quaternary loess (SLAPS Unit 2), glacio-lacustrine sequences (SLAPS Unit 3), and basal sands and gravels (SLAPS Unit 4). Beneath these unconsolidated deposits, the bedrock is composed of Pennsylvanian shale bedrock (SLAPS Unit 5), and Mississippian limestone (SLAPS Unit 6). The shale bedrock overlies the limestone in the southwest portion of the site, but is absent to the east and north.

Four hydrostratigraphic zones have been identified at the Boeing Tract 1 site and are presented on Figure 5-1 with the corresponding hydrostratigraphic zones at the adjacent SLAPS. The hydrostratigraphic zones consist in descending order of the unconsolidated shallow groundwater zone, unconsolidated deep groundwater zone, shale bedrock zone, and limestone bedrock zone. The shallow groundwater zone (SLAPS “HZ-A”) consists of clay, silt, clayey silt, and silty clay (SLAPS Units 1, 2, and the upper portion of Unit 3 referred to as Sub-unit 3T). The deep groundwater zone (SLAPS HZ-B and HZ-C) consists of an upper organic silt layer overlying mostly clay and silty clay (SLAPS Sub-unit 3M), then a basal sand and gravel in a clay matrix with sporadic clean sand and gravel interval (SLAPS lower portion of Unit 3 referred to Sub-unit 3B, and Unit 4). The upper bedrock zone (SLAPS HZ-D) includes the Pennsylvanian Cherokee Group consisting of shale, siltstone, and coal and the underlying Pennsylvanian Marmaton Group consisting of shale, siltstone, limestone, sandstone, and coal (SLAPS Unit 5). The lower bedrock zone is the Mississippian Ste. Genevieve Limestone (SLAPS HZ-E) that consists of sandy limestone (SLAPS Unit 6). This limestone zone is the protected aquifer at SLAPS. As a result of the very low permeability of clayey intervals within the upper portions of the glacio-lacustrine sequence (SLAPS Sub-units 3M and 3B), vertical groundwater movement between the shallow and deep groundwater zones is limited.

5.2 DOMESTIC GROUNDWATER USE SUMMARY

The current and future domestic groundwater use pathway for the four groundwater zones is not complete considering the following:

- There are no groundwater supply wells at the site.
- According to the RFI (MACTEC, 2004b), eight private wells were identified within a 3-mile radius of the FUSRAP North County Site (USACE, 2003). Four are irrigation wells and one is an industrial supply well. Three other wells had been used for domestic

purposes, but were capped and abandoned in 1962, 1968, and 1979 (BNI, 1992). There is no probability of impact to these off-site wells since (i) the site COCs localized plumes have been defined on-site, and (ii) the groundwater flow direction is to the east and southeast away from the wells.

- The groundwater underlying the site will not be used in the future for drinking water purposes given (i) the industrial/urban setting, (ii) the zones could not provide an adequate quantity of water to support the commercial/industrial facilities typical of the airport vicinity, and (iii) the availability of an adequate public water supply system.
- The primary source for drinking water in the City of St. Louis and St. Louis County is surface water obtained from the Missouri River, Mississippi River, and Meramec River. At its closest point, the Missouri River is about three miles to the northwest of the site and the groundwater flow is towards the east and southeast away from the river in the site vicinity.
- AULs will be implemented that prevent on-site use of groundwater for domestic purposes and prevent land use for residential or agricultural purposes.

Consistent with the above findings the risk assessments prepared by RAM (2004) and Tetra Tech (2008) were based on the understanding that groundwater at the site and in the immediate vicinity is not currently being used as a source for domestic use and will not be used for domestic purposes in the future.

5.3 GROUNDWATER CLASSIFICATION

The shallow groundwater zone at the site is equivalent to the "HZ-A" groundwater interval at SLAPS per Section 2.7.3.1 of the RFI (MACTEC, 2004b). The "HZ-A" interval at SLAPS is not a current or future potential source of drinking water due to its poor quality and very low yields per Sections 2.5.4 and 2.6.2 in the Record of Decision (ROD) for the North St. Louis County Sites (USACE, 2005). Section 2.5.4 of the ROD further states that "HZ-A" is Class IIIA groundwater using the Superfund Ground Water Classification Flow Chart (USEPA, 1986). Class IIIA includes groundwater that is not a source of drinking water, is of limited beneficial use, and feeds a surface-water body (e.g., the Missouri River) that could be used for drinking water. Class IIIA also includes groundwater where yields are insufficient to meet the needs of an average size family. Section 2.5.4 of the ROD states that the soils of unit "HZ-A" have such fine-grained matrix that the recovery rates for sampling are extremely low. Although the sample wells are not equivalent to wells for water production, the low recovery rates in the monitoring wells indicate that water supply wells completed in this unit would not be able to sustain pumping rates capable of meeting the needs of individual private residences. As quoted in the ROD regarding the "HZ-A" zone; "There is no known use for groundwater of such poor water quality and low yield under any of the current or reasonably anticipated land uses."

5.4 PROPOSED REMEDY

As discussed above, the groundwater is currently not being used nor will it be used in the reasonable future. As stated previously, the shallow groundwater interval at the site is equivalent to the "HZ-A" interval at SLAPS, which is Class IIIA under the USEPA classification system, and thus, not usable for drinking water purposes currently or in the foreseeable future. Further, the AULs provide an additional level of protection against groundwater use. The draft AULs are included in Appendix I; these measures are sufficient to confirm that exposure to groundwater as a drinking water supply does not occur. As an additional added measure, the proposed remedy includes MNA, which will provide confirmation of additional remediation that will continue to decrease VOC mass and concentrations, as will be demonstrated by collecting and evaluating the data.

MNA refers to the use of natural processes to provide beneficial groundwater remediation. Natural attenuation processes include the combination of biodegradation, dispersion, dilution, sorption, and volatilization. This remedy is most applicable in combination with source control. As discussed in Section 1.2.3, numerous source area removal activities and interim remedial measures have been implemented at the site and as a result of which, source control has been achieved. This has been confirmed by recent monitoring data that has shown groundwater concentrations are stable across the site and are decreasing in several locations. In particular, due to low permeability and gradient and low velocities, there is minimal expansion of the impacts. Continuation of the interim remedial measures in Sub-areas 2B and 6B has been proposed to further reduce residual groundwater concentrations and contaminant mass.

The benefits of MNA at this site include (i) low level of intrusiveness, as surface structures/treatment facilities will not be required, (ii) generation of minimal remediation waste and expenditure of the least amount of energy and is hence the most environmentally sustainable action, (iii) past experience at the site indicates that this method will result in the destruction of COCs to harmless products, (iv) protective of risk to human health and the environment relative to more active and aggressive forms of remediation; and (v) provides continuing confirmation of stable or decreasing groundwater concentrations.

5.4.1 Monitored Natural Attenuation Approach

Consistent with standard MNA guidances, the recommended MNA program will consist of elements that provide:

1. Evidence that groundwater concentrations are stable or decreasing;
2. Multiple lines of geochemical evidence to evaluate trends;
3. Annual reports with data presentation and evaluation of the monitoring program;
4. Five-year evaluations of the various remedy components, including MNA; and

5. Contingency plans if changing conditions are observed that are not addressed by the defined program.

Each of the elements of the MNA program is described in the following sections.

5.4.2 Stable or Decreasing Groundwater Concentrations

As discussed previously in Sections 1.2.3.2 and 1.2.3.3, evidence of enhanced natural attenuation has been documented following prior interim actions at the site, including at Sub-areas 2B and 6B. Groundwater monitoring has been conducted since 1988. Additional groundwater sampling, supplementing past monitoring, will initially be performed on a semi-annual basis for two years (2012 and 2013). Groundwater samples will be analyzed for VOCs using EPA Method 8260, in particular for the SCOCs and associated daughter products with appropriate laboratory reporting limits. Groundwater monitoring will be performed in accordance with the approved Quality Assurance Project Plan (QAPP) (RAM Group, 2010l).

Stable or decreasing concentrations would confirm that natural attenuation continues to provide ongoing remediation of the SCOCs.

5.4.3 Geochemical Parameters

Geochemical parameter monitoring will be conducted to confirm conditions are consistent with continued effectiveness of MNA. Parameters will be sampled at an upgradient location in Sub-areas 2B and 6B to indicate representative values of these parameters in locations upgradient of known impacted areas. This will provide indications if upgradient conditions change over time that could affect plume behavior and also establish a baseline for onsite areas. Other wells in each sub-area that will be analyzed for natural attenuation parameters will at a minimum include the following:

- One source area well,
- One downgradient impacted well,
- One downgradient non-impacted well, and
- Two lateral wells (one on each side of the plume).

The monitoring wells to be sampled for geochemical parameters are listed on Table 5-1 and the locations are shown on Figure 5-2. Monitoring wells in this program include, but are not necessarily limited to, those placed to measure changes in the nature of the plume and boundary wells strategically placed to detect migration of contaminants downgradient of the current extent of the plume. As indicated in Section 5.4.4, the monitoring program may be periodically revised as data is collected and evaluated.

One round of geochemical parameters will be collected during the first sampling event. Collection of additional data will be determined based on the results of the first round. Table 5-2 provides descriptions of specific analyses, data uses, and sampling and handling guidelines for natural attenuation assessment. The first round of natural attenuation groundwater sampling at the site will include the following:

- Dissolved total organic carbon (laboratory);
- Dissolved oxygen (field meter, flow through cell);
- Redox potential (field meter, flow through cell);
- Temperature, pH, conductivity, i.e., general water quality parameters (field meter, flow through cell);
- Alkalinity (field test kit or laboratory);
- Nitrate (field test kit or laboratory);
- Ferrous iron (field test kit or laboratory);
- Sulfate (field test kit or laboratory); and
- Methane, ethene, and ethane (laboratory).

After initial geochemical conditions are established, geochemical monitoring will be performed on an annual basis and analyzed for dissolved oxygen, redox, major terminal electron acceptor parameters (i.e., dissolved sulfate, nitrate, ferrous iron, and methane), and any other parameters that vary by location and provide useful information for evaluating / demonstrating MNA. After the first two years, the frequency and list of analytes will be re-evaluated to focus subsequent sampling of parameters that may vary and would provide useful information in monitoring the progress of MNA.

5.4.4 Multiple Lines of Evidence

Monitoring of SCOCs and geochemical parameters will be used to evaluate the occurrence and extent of MNA and potential for continuing remediation via MNA. Evaluation of MNA will primarily be performed using the following two lines of evidence consistent with typical protocols such as EPA guidance (USEPA, 1997):

- (1) *Historical ground water and/or soil chemistry data that demonstrate a trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points.* This will be documented by the following:
 - a. Decreasing parent compound concentrations over time and space;
 - b. Increasing chlorinated daughter compound concentrations (e.g., cis-1,2-DCE, vinyl chloride, ethene, and ethane); and
 - c. Stable or decreasing dissolved concentrations.
- (2) *Hydrogeologic and geochemical data that can be used to demonstrate indirectly the types of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels.* This will be documented by the following:
 - a. Corresponding trends of electron acceptors and donors, including continued presence to support continued attenuation;
 - b. Reducing conditions or anaerobic geochemical profile; and/or
 - c. Increasing metabolic byproduct concentrations (e.g., methane, alkalinity).

The presence of daughter products provides evidence that contaminants are being destroyed. These daughter products would not be present in the absence of biodegradation processes.

Further, concentration trends of the parent compounds can demonstrate whether the plume is stable or decreasing. Reduction in contaminant concentration could be the result of advection, dispersion, dilution from recharge, sorption, and volatilization (i.e., the majority of apparent contaminant loss could be due to dilution). The presence and proportion of degradation daughter products provides evidence of biodegradation processes compared to other attenuation processes.

The second line of evidence, i.e. the measurement of geochemical parameters, will provide additional evidence of MNA and demonstrate whether conditions remain consistent with continuing remediation via MNA.

The monitoring program may be periodically revised as data is collected and evaluated and will be designed to accomplish the following:

- Confirm that natural attenuation is progressing as predicted;
- Verify that groundwater concentrations are stable or decreasing;
- Identify any mobile transformation products affecting effectiveness of MNA;
- Detect any previously unknown releases of contaminants; and
- Confirm the efficacy of the institutional controls.

The first priority (i.e., primary line of evidence) will be the development of an appropriate database of SCOC concentration trends over time and space.

5.4.5 Annual Reports

Annual reports will be provided that summarize and present data collected for the year. These reports will be distributed within 60 days after the end of the calendar year. As appropriate, SCOC and geochemical parameter results will be presented on site maps. The SCOC concentration distribution or iso-concentration plots for individual sampling events will be prepared on the same scale and presentation so that changes over time can be evaluated. Analytical models will be used to support discussions of potential continued migration of contaminants in groundwater.

Similar iso-concentration plots will be prepared for select geochemical parameters for which variation in concentrations are observed in collected samples. These geochemical iso-concentration maps will use the same scale as contaminant plume maps so that they can be visually compared and superimposed. These maps and plots will be reviewed to differentiate patterns of biodegradation via different potential mechanisms.

COC concentration versus time plots will be updated in each annual report for all groundwater monitoring wells sampled for MNA purposes. Concentration trend analysis will be used to evaluate plume behavior. Variations in COC concentrations will be identified and discussed.

5.4.6 5-Year Review

Boeing plans to continuously evaluate the protectiveness of the remedy. A formal review of the remedy will be conducted every five years or more frequently if necessary to ensure the

protectiveness of the remedy to allow Boeing to incorporate advances in technology that can improve or accelerate the remedy, as well as to remove sections from the permit.

In June 2001, USEPA issued the *Comprehensive Five-Year Review Guidance (EPA 540-R-01-007)* to aid USEPA regions and other agencies with responsibilities for conducting Five-Year Reviews at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. For purposes of evaluating the effectiveness and protectiveness of the remedy, this sub-section incorporates certain aspects of the five-year review process. These periodic reviews will continue until such time as site closure is granted by the agencies or Boeing and the agencies decide that such reviews are not necessary.

Boeing will conduct the Five-Year Review by submitting a written proposed protectiveness determination to the agencies. The Five-Year Review process will integrate information taken from decision documents, the CMS, and operational data with the experiences of those responsible for and affected by actions at the site. This review will incorporate the following six components:

1. Community involvement and notification,
2. Document review,
3. Data review and analysis,
4. Site inspection,
5. Interviews, and
6. Protectiveness determination.

Boeing working with MDNR will use these components or a modification of the components deemed necessary to assess the remedy's performance, and ultimately, to determine the protectiveness of the remedy.

5.4.7 Contingency Plan

The use of MNA will include contingency planning provisions. Contingency planning includes specific measures to be taken if changed conditions are observed that are inconsistent with the ongoing MNA program. One or more trigger criteria will be established that will serve to signal unacceptable performance of MNA and indicate when the contingency measures should be implemented. Since the site has multiple areas/sub-areas with varying sources and COCs, the response to triggering criteria in one area would likely be different to that in another area. Therefore, the response actions will be specific to the location, sources, and triggering criteria. As an example, if any of the following conditions occur over two consecutive groundwater monitoring events; contingency actions will be considered for implementation:

- Groundwater contaminant concentrations exhibit an unpredicted and sustained increasing trend;
- Groundwater contaminants are detected at significant and verified concentrations in monitoring wells located downgradient of the plume that were previously not impacted;
- or

- Byproducts are generated at concentrations that would affect risk calculations.

Other triggers that may cause the implementation of contingency actions include the following:

- Changes in land and/or groundwater use that affects the protectiveness of the MNA remedy.

Examples of contingency actions that will be considered include:

1. Verification sampling to confirm increases;
2. Increase in monitoring frequency for specific monitoring wells;
3. Increase in the number of monitoring wells to the monitoring plan; and
4. Evaluation of the additional data collected to determine the cause of the increases if verified and selection of actions to mitigate the increases.

Contingency mitigation measures may include some of the following:

1. Elimination of any unknown sources that may be identified;
2. Removal, treatment, or control of previously unknown sources; and
3. Implementation of other active or passive remedial technologies as warranted by a detailed evaluation of the data.

Remedial actions may include some of the following:

1. Additional injections of chemicals to enhance degradation of COCs. Such chemicals may include ISCO agents, HRC, or other agents; and
2. Active remedial actions, such as containment, air sparging, pump and treat, multi-phase extraction, and/or excavation.

SECTION 6.0

FUTURE RISK AND GROUNDWATER CONCENTRATION STABILITY

This section addresses Issue No. 4 related to confirmation that future risks from complete exposure pathways will not exceed the prevailing MDNR-specified criteria. As discussed in Section 2.0 neither the current nor the reasonable future risks to the commercial worker exceeded the regulatory acceptable levels. To confirm that future risks are acceptable, it is necessary to demonstrate that the groundwater concentrations do not increase such that future representative concentrations will not be higher than current concentrations. This condition will ensure that future risks will be less than current risks and hence acceptable.

To confirm continued stability of groundwater concentrations, groundwater monitoring will be conducted for a period of time sufficient to show a reliably consistent stable or decreasing trend in groundwater concentrations. The wells used to confirm stable/decreasing concentrations across the site will be integrated with the wells presented in Section 5.4.3 for the MNA program.

The selection of wells for groundwater monitoring will be based on the objective of evaluating stable groundwater concentrations across the site. Groundwater impacts at this site are not due to a single source, but are a result of several historic sources, which have been addressed by interim remedial measures discussed in Section 1.2.3. The monitoring plan is based on the recognition that there are several small mostly localized plumes. Each risk area/sub-area had one or more different sources, and potentially different COCs.

6.1 GROUNDWATER MONITORING WORK PLAN

The work plan includes selection of COCs, areas and sub-areas to be monitored, monitoring wells, groundwater sampling methods, laboratory analysis parameters, quality assurance and quality control (QA/QC) procedures, data evaluation criteria to demonstrate groundwater concentration stability, and schedule and reporting. Groundwater monitoring will be performed in accordance with the approved QAPP (RAM Group, 2010).

6.1.1 Selection of Chemicals of Concern for Groundwater Monitoring

Conservatively, all chemicals for which the individual risks were within a factor of 10 of the acceptable risk were selected. Specifically, all COCs with risk greater than IELCR of 1×10^{-6} or HQ of 0.1 were included. The factor of 10 was selected because considering that the sources have been removed, it is highly unlikely that concentrations will increase by a factor of 10.

Chemicals that meet the above criteria are listed on Table 6-1 and include nineteen chemicals. Of these, the following six chemicals had very few concentrations above the reporting limits. Therefore, these six COCs have been eliminated from the monitoring plan as explained below:

Sub-area 3H

- Methylene chloride
 - It is known that this is a common laboratory contaminant.

- Three samples were analyzed. One sample had a detected concentration of 5.3 µg/L (J-value) and two samples had concentrations below reporting limits (<5 µg/L and <20 µg/L).
- The risk within a factor of 10 of target risk is due to outdoor inhalation of vapors from groundwater by the construction worker (Tetra Tech, 2008). These calculations are based on highly conservative assumptions resulting in a considerable overestimation of risks.
- Mercury
 - One sample was analyzed and had a concentration of 0.5 µg/L in 2003.
 - Seven samples from two wells were collected in 2008 and 2010. Of these samples, one sample had a concentration of 0.06 µg/L (J-value) and six samples had concentrations below reporting limits (<0.2 µg/L). The latest three samples indicated concentrations below the reporting limits.
 - The risk within a factor of 10 of target risk is due to outdoor inhalation of vapors from groundwater by the construction worker (Tetra Tech, 2008). These calculations are based on highly conservative assumptions resulting in a considerable overestimation of risks.

Sub-area 6B

- Aroclor 1254
 - Historically, 14 samples were collected. Of these, 12 samples had concentrations below reporting limits (<0.5 to <1.0 µg/L). Only two samples had detected concentrations (11 µg/L at RC1 and 580 µg/L at RC2 in 2000).
 - The risk within a factor of 10 of target risk is due to dermal contact with groundwater by the construction worker (Tetra Tech, 2008). The EPC used to calculate the risk for this pathway was based on the maximum detected concentration.
 - In 2008 and 2010, nine samples from six wells were collected. All nine samples had concentrations below reporting limits (<1.0 to <2.08 µg/L). Therefore, the risk based on the recent results will be significantly lower than a factor of 10 of target risk.
 - The primary contribution to risk in Sub-Area 6B is from chlorinated solvents.
- Benzo(a)anthracene
 - Historically, 11 samples were collected. Of these, one sample had detected concentration of 250 µg/L (at RC2 in 2000) and ten samples had concentrations below reporting limits (<5 µg/L).
 - The risk within a factor of 10 of target risk is due to dermal contact with groundwater by the construction worker (Tetra Tech, 2008).
 - In 2008 and 2010, 13 samples from eight wells were collected. All 13 samples had not-detected results (<10.0 to <17.0 µg/L). Based on the recent analytical results, the risk for this pathway will be lower than a factor of 10 of target risk.
 - The primary contribution to risk in Sub-area 6B is from chlorinated solvents.

- Chloroform
 - It is known that this is a common laboratory contaminant.
 - Historically, 157 samples were collected. Of these, six samples had detected concentrations (from 5.4 to 11.0 µg/L) and 151 samples had concentrations below reporting limits (<1.0 to <500 µg/L).
 - The risk within a factor of 10 of target risk is due to outdoor inhalation of vapors from groundwater by the construction worker (Tetra Tech, 2008). These calculations are based on highly conservative assumptions resulting in a considerable overestimation of risks.
 - In 2008 and 2010, 21 samples from eight wells were collected. All 21 samples had concentrations below reporting limits (<5.0 to <1,000 µg/L).
 - The primary contribution to risk in Sub-area 6B is from chlorinated solvents.

- Dichlorodifluoromethane (Freon-12)
 - It is known that this is a common laboratory contaminant.
 - Historically, 124 samples were collected from 15 wells. Of these, two samples had detected concentrations (2.6 µg/L and 700 µg/L in 2003). The remaining 122 samples had concentrations below reporting limits (<1.0 to <100 µg/L).
 - The risk within a factor of 10 of target risk is due to indoor inhalation of vapors from groundwater by the indoor worker and outdoor inhalation of vapors from groundwater by the construction worker (Tetra Tech, 2008).
 - In 2008 and 2010, 21 samples from eight wells were collected. Of these, 20 samples had not-detected results (<10.0 to <2,000 µg/L). Only one sample had detected concentration of 2,000 µg/L with “J” laboratory qualifier, which is estimated concentration.
 - The detects (3 of 145 samples from up to 15 wells) are very few and sporadic.
 - The primary contribution to risk in Sub-area 6B is from chlorinated solvents; therefore, this chemical is not believed to be site related.

6.1.2 Areas and Sub-areas

Based on the above considerations, 11 areas/sub-areas, namely 2B, 2C, 3A, 3B, 3F, 3G, 3H, 4, 6B, 6C, and 9, had chemical concentrations that caused risks within a factor of 10 of the target risk or greater.

Five of these areas/sub-areas (3B, 3F, 3G, 4, and 9) do not have monitoring wells. The COCs in these areas/sub-areas consist mostly of TPH-GRO, TPH-DRO, and TPH-oil range organics (ORO). These chemicals readily biodegrade with time and the sources have been removed. Therefore, it is very unlikely that concentrations of these chemicals would increase with time. Additionally, risk was calculated using data collected prior to 2004; therefore, the current chemical concentrations should be less. Therefore, it is not necessary to install monitoring wells in these five areas/sub-areas.

6.1.3 Selection of Monitoring Wells

It is important to select monitoring wells based on the specific groundwater COCs in each area/sub-area. For this issue, wells used to estimate risk, i.e. wells within the source area and just downgradient of the source, will be sampled. Table 5-1 lists the 36 wells to be gauged and sampled, including 1 backfill, 28 shallow, 3 intermediate, and 4 deep zone wells. Figure 5-2 shows the location of these wells. Note that several of these wells overlap the monitoring required to address Issue No. 3, as discussed in Section 5.0.

6.1.4 Groundwater Sampling Methods

To the extent possible, groundwater sampling will be performed using snap sampling systems with a few wells using low-flow methods. Application of snap samples at this site has been approved by MDNR (MDNR, 2011). Of the 36 wells, about 24 wells will use snap samplers (wells that are 2-inch or greater diameter), and 12 wells will be sampled using low-flow methods (wells less than 2-inch diameter or that have occasional LNAPL). Table 5-1 indicates the preferred sampling method for each monitoring well. Low-flow sampling in addition to snap sampling may be needed at specific wells targeted for collection of MNA parameters to obtain adequate sample volume.

6.1.5 Laboratory Analysis Methods

The following laboratory analysis methods will be used for the COCs identified in Table 5-1:

- EPA Method 8260 for VOCs and/or TPH-GRO; and
- EPA Method 8270 for TPH-DRO and/or TPH-ORO.

Should there be increasing concentrations in TPH-GRO, TPH-DRO, or TPH-ORO, it may be necessary to select a few samples for fractionation analysis of the aliphatic and aromatic carbon ranges.

6.2 DATA EVALUATION CRITERIA

The data will be evaluated to demonstrate groundwater concentration stability. Some or all of the following methods will be used to evaluate the data:

1. Chemical concentration contour maps;
2. Concentration vs. time plots;
3. Concentration vs. distance plots; and
4. Statistical and visual analysis of plots.

6.3 SCHEDULE AND REPORTING

Groundwater monitoring will be performed on a semi-annual basis, data will be evaluated and a brief transmittal letter will be submitted to the agencies with the data. The transmittal letter will summarize the results of the sampling. Comprehensive reports will be submitted annually by

March 1 of the following year which will include the elements in the MDNR Annual Report Review Worksheet. These reports will include recommended adjustments to the sampling activities based on the data. Once groundwater concentration stability can be demonstrated, groundwater monitoring for Issue No. 4 will cease. Note it may be necessary to continue monitoring to address other issues presented in the previous sections.

6.4 PROPOSED REMEDY

The risks can increase if the representative groundwater concentrations were to increase. To confirm that future risk associated with groundwater impacts does not increase, it is necessary to demonstrate groundwater stability; i.e., decreasing or stable concentrations of chemicals in groundwater. This condition will ensure that future risks will be less than or equal to the current risks, and hence below MDNR-specified criteria.

To assess groundwater stability, groundwater monitoring will continue until it can be confirmed that the groundwater concentrations are stable/declining and meet the prevailing MDNR criteria for stable concentrations.

Should chemical concentrations show a sustained consistent increase in concentrations, then as part of the contingency plan, the circumstances of the increase will be evaluated to determine the cause. Concurrently, the data will be used to evaluate the risk. Based on the evaluation and the specific circumstances, it may be necessary to evaluate appropriate remedial actions for implementation.

SECTION 7.0

PROPOSED REMEDIAL ACTIONS

This section summarizes the remedies proposed in the focused CMS to address the following issues:

1. Risk exceedances to the future construction worker;
2. Presence of LNAPL in certain wells;
3. Exceedance of DWS; and
4. Future risk and groundwater concentration stability.

The remedies include MNA and AULs. These include restrictions regarding (i) groundwater use for potable purposes, (ii) use of the site for residential or other unrestricted purposes, (iii) use of the site for agricultural purposes, (iv) vapor intrusion into building structures for human occupancies in selected areas of the site, and (v) soil disturbance. MNA includes the periodic monitoring of several wells and the evaluation of the data to confirm groundwater stability and a reduction in concentrations.

These remedies are discussed below.

7.1 REMEDIAL ACTIONS

7.1.1 Remedial Actions to Address Risk to Construction Workers

The exposure to future construction workers is expected to be limited and controllable. Exposure can be anticipated and hence planned. The future construction worker exposures will be mitigated through the use of HASPs specific to the type and location of construction activity. The HASP would address the specific construction project activity and would specify the appropriate PPE, monitoring equipment, and procedures needed to protect the future construction worker.

These HASPs would only be needed for construction projects that require subsurface excavations in Sub-areas 2B and 6B if the construction results in contact with groundwater. The use of the HASP for future construction workers will continue until the groundwater monitoring data indicates that concentrations of the COCs below the calculated TCs have been achieved.

The requirement for use of HASPs for each of the sub-areas will be controlled through AULs and the SMP.

7.1.2 Remedial Actions to Address LNAPL

As discussed in Section 4.0, no remedial action is necessary to address the trace presence and sporadic occurrence of LNAPL in Area 1 and Sub-areas 2A, 2B, 2C, 3C, and 6B. This is so because:

1. Significant interim remedial measures implemented to date have recovered LNAPL to the extent practicable.
2. The sporadic and trace occurrence of LNAPL, most likely due to water table fluctuations or barometric fluctuations, is unpredictable and further LNAPL cannot be recovered.
3. The residual LNAPL is highly weathered and not an on-going source of hydrocarbon constituents to the groundwater.

7.1.3 Remedial Actions to Address Exceedance of Drinking Water Standards

Data indicates that groundwater concentrations exceed DWSs for 12 chemicals in four sub-areas at the site; however, the site groundwater is not currently being used for potable purposes nor will it be in the future. Since the sources of these chemicals have been removed or abated by prior interim remedial measures, a combination of AULs and MNA is the proposed remedy. Historic data indicates that the proposed remedy will be sufficient to achieve goals of short term protection, intermediate performance, and final site closure.

Short term goals include (i) prevention of human exposure to unacceptable levels of COCs and (ii) prevention of further degradation of groundwater. Intermediate performance goals are measures that demonstrate progress toward achieving regulatory approval for final site closure. Goals to demonstrate feasibility for site closure include (i) protection of human health and the environment, (ii) media cleanup objective of returning “usable” water to its maximum beneficial use, and (iii) to reduce and eliminate, to the extent possible, further releases.

7.1.4 Remedial Actions to Address Future Risk and Groundwater Concentration Stability

Risk to future occupants of the site will be controlled by a combination of AULs and groundwater monitoring. AULs will ensure that land use remains commercial/industrial and the groundwater monitoring will confirm that the groundwater concentrations are stable and/or decreasing. Groundwater monitoring will be used to monitor, verify, and document groundwater concentration stability. If the groundwater concentrations are stable or decreasing, monitoring may be discontinued upon concurrence with the MDNR. Note it may be necessary to continue monitoring to address other issues. If significant continued increasing trends in chemical concentrations occur, then active measures will be evaluated and applied, if necessary, based on the specific situation.

SECTION 8.0

EVALUATION OF FINAL CORRECTIVE MEASURE ACTIONS

The selected final remedy consists of MNA and AULs to ensure future risks remain protective of human health and the environment, concentrations continue to decrease, and prevent further degradation of groundwater.

This section presents documentation that the proposed final remedy complies with each of the five standards (USEPA, 1994). Specifically, these include:

- Protect human health and the environment;
- Attain media cleanup standards set by the implementing agency;
- Control the source of releases so as to reduce or eliminate, to the extent practical, further releases that may pose a threat to human health and the environment;
- Comply with any applicable standards for management of wastes; and
- Other factors
 - Long-term reliability and effectiveness;
 - Reduction in toxicity, mobility, or volume of wastes;
 - Short-term effectiveness;
 - Implementability; and
 - Cost.

The following subsections discuss the above criteria for each action.

8.1 PROTECT HUMAN HEALTH AND THE ENVIRONMENT

Corrective measures technologies and the final remedy must be protective of human health and the environment. The risk exceedances, as discussed in Section 3.0, are only for future construction worker exposures to dermal contact with groundwater in two sub-areas.

The AULs and SMP are designed to be protective of human health for the construction worker. The AULs provide restrictions on residential and agricultural use of property and use of future groundwater. The AULs also provide protection against vapor intrusion pathway for construction of future occupied buildings. This pathway will be evaluated prior to construction and appropriate modifications will be made to the construction plans if the vapor intrusion pathway is complete. The AULs specify that any soil excavations or disturbances shall be performed under the MDNR approved SMP. Therefore, the AULs provide adequate protection for human health. MNA is performed to demonstrate a shrinking plume, and will provide an early warning of the possibility of future risk exceedances. If the concentrations of the COCs or their toxic byproducts show an increase, an appropriate contingency plan will be implemented in a timely manner.

Different portions of the site are owned by Boeing, GKN, and the Airport and access to all areas is strictly controlled by security personnel, fencing, and access badges. These entities also have strict requirements for use of HASPs, PPE, monitoring, OSHA training and medical surveillance for personnel and contractors involved in construction that access impacted sub-surface soil or groundwater. Additionally all excavations are governed by the SMP. Therefore, these controls will ensure the success of the AULs and protection of human health.

8.2 ATTAIN MEDIA CLEANUP STANDARDS

The TCs were calculated in Appendix F for chemicals that exceeded the target risk levels due to dermal contact with groundwater by the construction worker. MNA and the associated groundwater monitoring will demonstrate that these TCs have been consistently met and confirm that TCs have been attained that are protective of the groundwater. Note the contingency plan that is a part of the proposed remedy will ensure the groundwater impacts continue to be addressed if changed conditions are observed.

8.3 CONTROL SOURCES OF RELEASES

All known sources have been removed as a result of numerous past removal actions and interim actions, and only residual impacts remain. All except SWMUs #3 and #21 associated with Boeing's active WWTP, have been closed or are no longer in use (refer to Table 1-6). Of the 68 USTs, one is still present and active for storage of wastewater treatment sludge (refer to Table 1-7).

8.4 COMPLY WITH APPLICABLE WASTE MANAGEMENT STANDARDS

Per the activities recommended in this focused CMS, the only wastes generated will include investigation-derived wastes consisting of purged groundwater, decon water, and disposables. Disposables will also be generated by the future construction worker related to PPE and monitoring required under the area-specific HASPs and SMP.

All wastes will be handled, stored, transported and disposed following applicable local, state, and federal requirements for Boeing activities.

Construction activities may also generate impacted soil wastes during excavation activities and impacted waste groundwater during dewatering activities. Excavated soil will be managed in accordance with the SMP and waste groundwater will be treated at the Boeing WWTP.

8.5 OTHER FACTORS

Other general factors were also considered in evaluation and selection of remedial components, consistent with standard guidance such as USEPA's (1994a) *RCRA Corrective Action Plan*. These factors represent a combination of technical measures and management controls, including an evaluation of long-term and short-term effectiveness, waste-reduction effectiveness, implementability, and cost. This section addresses the physical and administrative feasibility of implementing remedial systems. Physical feasibility relates to the constraints that could inhibit

the installation/construction of remedial systems including buildings and access considerations. Administrative feasibility includes issues such as permitting and regulatory considerations.

8.5.1 Long-term Reliability and Effectiveness

8.5.1.1 Area-specific Health and Safety Plans

HASPs are reliable and effective as long as there is adequate control over the construction activities that will cause potential exposure to the future construction worker to impacted subsurface materials. It is also important that the HASPs are developed for each specific sub-area and address the specific chemicals, media, and depths of impact that cause risk exceedances to the workers. The area-specific HASPs must be further modified for each use based on the specific worker activities planned and the current sub-surface conditions. AULs and the SMP will require the use of HASPs for those specific sub-areas with risk exceedances to the future construction worker.

8.5.1.2 Activity and Use Limitations

AULs that are durable, reliable, and enforceable are reliable and effective for protecting potential receptors from subsurface impacts, thereby eliminating possible human exposure pathways to impacted groundwater and subsurface soil. The AULs will be used to:

- Prevent on-site groundwater use for potable purposes;
- Prevent future on-site land use for residential or other non-restricted purposes;
- Prevent future on-site land use for agricultural purposes;
- Restrict construction of occupied buildings without first evaluating the vapor intrusion pathway and implementing mitigation measures into the construction plans if necessary; and
- Restrict intrusive construction or maintenance that causes soil disturbance without assessing subsurface conditions and performing work activities under the control of an appropriate HASP.

8.5.1.3 Site-wide Monitored Natural Attenuation

MNA is an effective and reliable method to obtain data for the evaluation of groundwater concentration stability and is the typical industry practice. MNA includes biodegradation mechanisms that will provide effective remediation of site contaminants. MNA incorporates groundwater monitoring, which is an effective and reliable method to confirm continued remediation and stable or decreasing groundwater concentrations. The groundwater monitoring plan will specify the monitoring wells to be sampled, the chemicals and methods for laboratory analysis, and the QA/QC procedures to be used. The MNA parameters and procedures are presented in Section 5.4.

8.5.2 Reduction in Toxicity, Mobility, or Volume of Wastes

8.5.2.1 Area-specific Health and Safety Plans

HASPs will not cause a reduction in toxicity, mobility, or volume of wastes; however, HASPs will prevent unacceptable exposures to the affected future construction workers.

8.5.2.2 Activity and Use Limitations

AULs will not cause a reduction in toxicity, mobility, or volume of wastes; however, AULs will prevent unacceptable exposures to human receptors.

8.5.2.3 Site-wide Monitored Natural Attenuation

Natural attenuation is an effective method for reduction in toxicity, mobility, and volume of wastes and monitoring will be used to verify that the groundwater concentrations are stable or decreasing; thus, providing a mechanism for determining if these reductions are occurring. Combined with the contingency measures, MNA will ensure reduction in the toxicity, mobility, and volume of waste.

8.5.3 Short-term Effectiveness

The short-term effectiveness of proposed corrective measures technologies is determined by how quickly the remedy can be implemented and indicates positive results.

8.5.3.1 Area-specific Health and Safety Plans

HASPs can be implemented immediately and will be effective in preventing unacceptable exposures to future construction workers in the two sub-areas with risk exceedances.

8.5.3.2 Activity and Use Limitations

AULs can be implemented immediately and will be effective in preventing the following:

- Potable use of on-site groundwater;
- Unrestrictive property use for residential and agricultural purposes;
- Construction of occupied buildings without first evaluating the vapor intrusion pathway and implementing mitigation measures into the construction plans if necessary; and
- Intrusive construction or maintenance that causes soil disturbance without assessing conditions and performing work activities under the control of an appropriate HASP.

Draft AULs are included in Appendix I.

8.5.3.3 Site-wide Monitored Natural Attenuation

Natural attenuation is an ongoing natural process and monitoring can be implemented immediately and will be effective in evaluating groundwater concentration stability. The data collected in the future will be used with the data collected since 2008 to evaluate the trends.

8.5.4 Implementability

Implementability describes the relative ease of installation (i.e., constructability). The constructability of a remedial system is related to the conditions of the site, the availability of resources, and what measures can be taken to facilitate construction. External factors include permits or access agreements, equipment availability, and location of appropriate on-site treatment or disposal facilities.

8.5.4.1 Area-specific Health and Safety Plans

HASPs are easy to implement and will be required by AULs and SMP for the sub-areas with future construction worker risk exceedances.

8.5.4.2 Activity and Use Limitations

AULs are easy to implement once accepted and approved by the Airport, GKN, and Boeing, as well as, the regulatory agencies. Refer to Appendix I for draft AULs.

8.5.4.3 Site-wide Monitored Natural Attenuation

Natural attenuation is an ongoing natural process and monitoring is easy to implement and will be easier since the agencies have approved the use of passive sampling systems (snap samplers) site-wide. A few wells will continue to be sampled using low-flow methods; however, the majority of the wells will utilize snap samplers. This will make sampling more efficient and provide consistent results, since there are very few variables in the snap sampler methodology in comparison to other non-passive methods.

8.5.5 Cost

It is not necessary to develop costs for comparison of actions, since the recommended methods have been determined. However, costs are important in identifying the necessary costs for financial assurance. The costs going forward will include the following:

- Development of area-specific HASPs and modifications to address specific future construction worker activity for each activity;
- Maintaining and verifying the AULs are in place and up-to-date, durable, reliable, and enforceable on an annual basis and reporting such to the agencies;
- Periodic groundwater monitoring and annual reporting to the agencies; and

- Closure of monitoring wells, as approved by the agencies.

SECTION 9.0

RECOMMENDED FINAL CORRECTIVE MEASURE ACTIONS

The recommended remedial actions are presented in the following sections.

9.1 REMEDIAL ACTIONS TO PROTECT CONSTRUCTION WORKER

The risk exceedances due to dermal contact with groundwater by the future construction worker are in Sub-areas 2B and 6B. Therefore, the recommended remedial action is:

- Use of area-specific HASP specific to each of these sub-areas to protect the future construction worker from unacceptable exposures. The HASP should include the appropriate PPE and monitoring based on the following criteria in each sub-area:
 - Specific COCs causing the exceedance;
 - Specific locations within the sub-area with exceedances; and
 - Depth to groundwater.

The specific details of the HASP will be determined on a project-by-project basis and if necessary, the HASP will be modified based on the potential exposures related to the specific project requirements, such as:

- Specific location within the sub-area;
- Ground surface covering;
- Depth of excavation and potential contact with groundwater;
- Nature of the construction activities;
- Longevity of exposure; and
- Current sub-surface conditions.

The need to continue utilizing the HASP for future construction worker activities should be based on the results of the groundwater monitoring in those specific sub-areas. When the representative concentrations in groundwater are below the calculated TCs for that sub-area, the HASP will no longer be needed.

9.2 REMEDIAL ACTIONS TO ADDRESS EXCEEDANCE OF DRINKING WATER STANDARDS

Since 2008, 12 chemicals have exceeded their DWS (as defined in Section 1.3.4) at least once during groundwater sampling events at various locations in four areas/sub-areas. However, it has been determined that the drinking water pathway is not complete at the site nor is it likely to be complete in the future. To prevent future use of the site groundwater for drinking water purposes, AULs will be implemented. In addition, a MNA remedy is recommended.

9.3 REMEDIAL ACTIONS TO ADDRESS FUTURE RISK AND GROUNDWATER CONCENTRATION STABILITY

Groundwater monitoring will be used to monitor, verify, and document groundwater concentration stability. The data will be evaluated to determine if the groundwater concentrations are stable or decreasing. If the groundwater concentrations are stable or decreasing, changes to the monitoring plan including discontinuation of some or all wells will be discussed. If persistent increasing trends in chemical concentrations occur in an area, then a contingency plan will be implemented. This plan may include active remediation.

9.4 SUMMARY

Following are the recommended actions to manage risk:

1. AUL, SMP, and HASPs for construction worker;
2. AUL to prevent groundwater use;
3. AUL to confirm continued commercial land use;
4. AUL to prevent vapor intrusion into occupied buildings;
5. MNA; and
6. Monitoring to confirm future risks remain acceptable until groundwater concentrations are demonstrated to be stable or declining.

SECTION 10.0
RISK MANAGEMENT PLAN

The focused CMS result has identified the sub-areas with risk exceedances, groundwater concentrations that exceed DWSs, and groundwater concentration stability issues. Remedial actions to address these specific issues have been recommended.

Once the recommended actions have been approved by the agencies, a risk management plan will be prepared to present the steps and schedule needed to implement the corrective actions. The Risk Management Plan will be prepared in accordance with Section 12 of the *Departmental MRBCA Guidance Document* (MDNR, April 2006, Updated June 2006 and June 2008).

SECTION 11.0
PUBLIC INVOLVEMENT PLAN

The proposed final remedy recommended in the CMS will undergo public review and comment before the final remedy will be selected. After the final remedy decision has been approved, the CMS will be implemented.

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Table 1-1
Exposure Areas
Boeing Tract 1, Hazelwood, Missouri

Area	Sub-area	Description
Area 1		Runway Protection Zone: Included Buildings 40, 45L, 45C, 45D, 45E, and parts of Buildings 45 and 45K. No building exists.
Area 2		Demolished Area: Included Buildings 45J, 48, 48A, 51, and 52, and part of Building 45K. Portions of two buildings (48 and 48A) are left.
	Sub-area 2A	Smallest of the three sub-areas consisting of the western portion of Area 2 and covers an area of 3.03 acres.
	Sub-area 2B	Largest of the three sub-areas consisting of the middle portion of Area 2 including SWMU 17 and covers an area of 4.48 acres.
	Sub-area 2C	Intermediate sized Sub-area consisting of the eastern/southeastern portion of Area 2 and covers an area of 3.88 acres.
Area 3		Retained Area: included Buildings 42, 43, 41, 44, 44A, 46, 49, 1, 2, 3, 4, and 45H. Currently there are nine buildings and a large parking lot.
	Sub-area 3A	Trapezoidal and located in the northwestern portion of Area 3 and covers about 5.25 acres. Existing Buildings/structures 44, 44A, 46, and 49, western portion of Building 41, northern edge of Building 42, and associated parking lots and access areas primarily to the west and south of these buildings.
	Sub-area 3B	Open area between existing Buildings 2 and 42 including the parking access area on the western side of existing Building 2.
	Sub-area 3C	All but the northern edge of existing Building 42, existing Building 43, several former buildings/structures to the south of existing Building 42, and associated paved parking and access areas primarily to the east and south of these buildings to the runway on the south.
	Sub-area 3D	Eastern portion of Buildings 41, northern half of Building 2, and the associated open and parking areas on the west side of Building 2.
	Sub-area 3E	Small open area between existing Buildings 2 and 4 including parking and access areas.
	Sub-area 3F	Small rectangular area at the southwestern corner of existing Building 1, including parking and access areas and the southwest corner of existing Building 1.
	Sub-area 3G	Small rectangular area between Buildings 1, 2, and 3, including parking and access areas and the northeastern portion of Building 1 and the northwestern portion of Building 3.
	Sub-area 3H	Building 4 and the open access areas to the north, east, and south sides of the building.
Area 4		Power Plant: Includes former Building 5 and existing Building 6.
Area 5		Industrial Water Treatment Plant: Includes existing Building 14.
Area 6		GKN Facility: (includes existing Buildings 21, 22, 27, 28, 29, 29A, and 39, and former Building 25).
	Sub-area 6A	Existing Buildings 21, 29, and 29A, and all parking lots and open space to the south and west of these buildings.
	Sub-area 6B	The area between existing Buildings 29 and 27, containing existing Buildings 22, 28, 39.
	Sub-area 6C	Former Building 25 and existing Building 27 and parking lots and open space to the south of these buildings and within about 450 feet to the east.
	Sub-area 6D	Parking lots and open areas beginning about 450 feet east of former Building 25 and existing Building 27 and extending to the north, south, and east property lines.
Area 7		Engineering Campus: Includes Buildings 27A, 32, 33, and 34, and large parking lot.
Area 8		Office Complex North: Includes two buildings (220 and 221) separated by a small parking lot.
	Sub-area 8A	Southern portion of existing Building 220, associated parking areas to the south and access areas to the east.
	Sub-area 8B	Northern portion of existing Building 220 and the open area to the northwest of the building to the property boundary including smaller associated existing buildings, parking areas, and unpaved areas along the property boundary.
	Sub-area 8C	Existing Building 221 and the associated parking and access areas to the north, east, and west of the building.
Area 9		Gun Range: Includes five main buildings (10, 11, 11A, 12, and 13) and a parking lot.

Table 1-2
Primary Chemicals and Routes of Exposure that Cause Risk and Hazard Exceedances
Combined RAM Group and Tetra Tech Risk Assessments
Boeing Tract 1, Hazelwood, Missouri

Area	COC	Media	Exceedance Due to	Risk Assessment
Sub-area 2B	Tetrachloroethene (PCE)	GW	Dermal contact with groundwater by future construction worker	RAM Group
Sub-area 2C	Benzene	GW	Outdoor inhalation of vapors from groundwater by future construction worker	Tetra Tech
	TPH-GRO Aliphatics >C5 to C8	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	TPH-GRO Aromatics >C9 to C18	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
Sub-area 3H	Mercury	GW	Outdoor inhalation of vapors from groundwater by future construction worker	Tetra Tech
	TPH-DRO Aromatics >C9 to C18	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
Sub-area 6B	Benzo(a)anthracene	GW	Dermal contact with groundwater by future construction worker	RAM Group
	1,2-dichloroethene (total)	GW	Outdoor inhalation of vapors from groundwater by future construction worker	Tetra Tech
	Benzene	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	Trichloroethene (TCE)	GW	Outdoor inhalation of vapors from groundwater and dermal contact with groundwater by future construction worker	
	Vinyl chloride	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	Mercury	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	Aroclor 1254	GW	Dermal contact with groundwater by future construction worker	
	TPH-GRO Aliphatics >C5 to C8	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	TPH-GRO Aromatics >C9 to C18	GW	Outdoor inhalation of vapors from groundwater by future construction worker	
	TPH-DRO Aromatics >C9 to C18	GW	Outdoor inhalation of vapors from groundwater by future construction worker	

Notes:

TPH: Total petroleum hydrocarbons

GRO: Gasoline range organics

DRO: Diesel range organics

C: Carbon range

GW: Groundwater

Table 1-3(a)
Post Excavation Soil Confirmation Samples in Sub-Area 3A (µg/kg)
Boeing Tract 1, Hazelwood, Missouri

Sample ID	Date	VOC								TPH	
		Isopropyl benzene	n-Propyl benzene	P-Isopropyl toluene	sec-Butyl benzene	Acetone	cis-1,2-Dichloroethene	Vinyl chloride	n-Butyl benzene	TPH-GRO	TPH-DRO
B42-EXC-S-5	10/27/2005	90	130	71	270	<1,300	<50	<50	<50	340,000	<13,000
B42-EXC-W-5	10/27/2005	<56	<56	<56	<56	<1,400	<56	<56	<56	110,000	16,000
B42-EXC-E-5	10/27/2005	350	550	160	760	1,300	<45	<45	960	910,000	<13,000
B42-EXC-N-4	10/27/2005	25	<50	70	270	<1,200	<50	<50	<50	520,000	<13,000
B42-EXC-F-8	10/27/2005	<1.2	<1.2	<1.2	<1.2	39	54	22	<1.2	850	<12,000

Source: MACTEC Engineering and Consulting, Inc., 2006. *Interim Action Remedial Excavation Completion Report*, Boeing Tract 1, McDonnell Douglas, Hazelwood, Missouri, May 17.

Table 1-3(b)
Post Excavation Soil Confirmation Samples in Sub-Area 3E (µg/kg)
Boeing Tract 1, Hazelwood, Missouri

Sample ID	Date	VOCs													TPH
		1,2,3-Trimethylbenzene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Acetone	Ethyl benzene	Isopropyl benzene	Methyl ethyl ketone (MEK)	Naphthalene	n-Butyl benzene	n-Propyl benzene	P-Isopropyl toluene	sec-Butyl benzene	Xylenes, Total	TPH-GRO
B2-EXC-E-4	10/27/2005	<1.3	<1.3	<1.3	55	<1.3	<1.3	<13	<6.4	<1.3	<1.3	<1.3	<1.3	<3.8	<640
B2-EXC-S-4	10/27/2005	<1.3	<1.3	<1.3	52	<1.3	<1.3	<13	<6.6	<1.3	<1.3	<1.3	<1.3	<4	<660
B2-EXC-N-4	10/27/2005	<1.3	<1.3	<1.3	92	<1.3	<1.3	18	<6.4	<1.3	<1.3	<1.3	<1.3	<3.8	<640
B2-EXC-F-5	10/27/2005	<1.3	<1.3	<1.3	75	<1.3	<1.3	<13	<6.6	<1.3	<1.3	<1.3	<1.3	<3.9	<660
B2E5-09	11/4/2005	3,700	14,000	3,900	<160	4,700	810	<64	1,200	710	2,600	150	280	10,000	710,000

Source: MACTEC Engineering and Consulting, Inc., 2006. *Interim Action Remedial Excavation Completion Report*, Boeing Tract 1, McDonnell Douglas, Hazelwood, Missouri, May 17.

Table 1-3(c)
Post Excavation Soil Confirmation Samples in Sub-Area 6B (µg/kg)
Boeing Tract 1, Hazelwood, Missouri

Sample ID	Date	VOCs				TPH	
		1,1-Dichloroethane	1,2,3-Trichloropropane	Acetone	Vinyl chloride	TPH-DRO	TPH-ORO
REC-EXC-F-6	9/8/2005	3.2	1.4	73	4.6	200,000	380,000
REC-EXC-N-5	9/8/2005	<1.2	<1.2	110	<1.2	<12000	<12000
REC-EXC-S-4	9/8/2005	5.6	<1.3	60	17	<13000	13,000
REC-EXC-E-2	9/8/2005	<1.2	<1.2	32	<1.2	58,000	160,000
REC-EXC-W-5	9/8/2005	4	<1.3	<32	36	180,000	340,000

Source: MACTEC Engineering and Consulting, Inc., 2006. *Interim Action Remedial Excavation Completion Report*, Boeing Tract 1, McDonnell Douglas, Hazelwood, Missouri, May 17.

Table 1-3(d)
Post Excavation Soil Confirmation Samples in Sub-Area 8B (µg/kg)
Boeing Tract 1, Hazelwood, Missouri

Sample ID	Date	1,1,2,2-Tetrachloroethane	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2,3-Trichloropropene	Acetone	Carbon Tetrachloride	Methyl ethyl ketone (MEK)
B220-EXC-S-2	9/7/2005	2.1	2.2	3.9	2.1	1.6	<51	3.1	11
B220-EXC-E-3	9/7/2005	<1.3	<1.3	<1.3	<1.3	<1.3	110	<1.3	<13
B220-EXC-W-3	9/7/2005	<1.3	<1.3	2.1	2.2	<1.3	160	<1.3	15
B220-EXC-N-1.5	9/7/2005	<1.3	<1.3	2.1	2	<1.3	110	<1.3	16
B220-EXC-F-5	9/7/2005	<1.3	<1.3	<1.3	<1.3	<1.3	97	<1.3	<13

Source: MACTEC Engineering and Consulting, Inc., 2006. *Interim Action Remedial Excavation Completion Report*, Boeing Tract 1, McDonnell Douglas, Hazelwood, Missouri, May 17.

Table 1-4
Pre Interim Action Groundwater Concentrations for Detected Chemicals in SWMU-17 Area (µg/L)
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	cis-1,2-Dichloroethene	Tetrachloroethene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl chloride
B5111	10/21/2005	160	4.1	1.6	1.5	9.9
MW-51	10/21/2005	25,000	200,000	<500	23,000	1,200
MW-6S	10/21/2005	8	3.1	<1	<1	17
MW-7S	10/21/2005	4,800	82,000	<500	4,700	<500
TP-2	10/21/2005	5,500	24,000	<100	3,800	140
TP-4	10/21/2005	1,200	2,100	7.6	470	140

Source: MACTEC Engineering and Consulting, Inc., 2006. *Interim Measure Completion Report*, Solid Waste Management Unit 17, McDonnell Douglas, Hazelwood, Missouri, July 24.

Table 1-5
Building Dimensions
Boeing Tract 1, Hazelwood, Missouri

Sub-area	Building Number	Occupancy	Building Dimension			
			Width (ft)	Length (ft)	Height (ft)	Basement Height (ft)
2B	48	Vacant	102	446	25 est	N/A
	48A	Vacant	20 est	40 est	15 est	N/A
3C	42	Occupied	203	504	60 est	N/A
	43	Vacant	50	25	15 est	N/A
3D	2	Vacant	840	1100	70 est	25 est
3G	1	Vacant	172	406	60 est	25 est
	3	Vacant	82	202	40 est	20 est
6A	21	Occupied	75 est	525 est	15 est	N/A
	29	Occupied	375 est	750 est	60 est	N/A
	29A	Occupied	375 est	750 est	60 est	N/A
6B	22	Occupied	70	149	25 est	N/A
	28	Occupied	100	100	25	N/A
	39	Occupied	30	80	20	N/A
6C	27	Occupied	800	1000	45	20 est
7	27A	Occupied	200 est	300 est	60 est	N/A
	32	Occupied	62	341	45 est	15 est
	33	Occupied	200	280	90 est	15 est
	34	Occupied	61	280	45 est	N/A
8B	220	Occupied	316	778	40 est	N/A
8C	221	Occupied	202	330	40 est	N/A

Table 1-6
Summary of Solid Waste Management Units (SWMUs)
Boeing Tract 1, Hazelwood, Missouri

Area/ Sub-area	Unit	Description	Building	Current Status
1-HH	12	Waste Jet Aircraft and Hydraulic System Spillage, F-18 Silencer	45E	The UST was removed in 1993 and closure certification of the permitted tank was accepted by MDNR in 1993.
	13	Waste Jet Aircraft Fuel and Hydraulic System Spillage Storage Tank, Hush House	45C/45D	The UST was removed in 1989. Ground water monitoring and product recovery was conducted in the area of this UST from 1990 to 2002. MDNR issued a NFA letter in 2002. Closure certification for this permitted tank was not submitted.
	23	Less-Than-90-Day Storage Area	45C/45D	Waste storage was discontinued at this area in 2001.
	26	Former Less-Than-90-Day Storage Area	40	Interim action as required under the corrective action conditions of the hazardous waste facility permit was conducted in 1997. Waste storage at this area had been discontinued prior to the RFA.
1-SOB45	14	Waste Jet Aircraft Fuel Storage Tanks, Fuel Pits #3 and #4	45	The UST was removed in 1992. Ground water monitoring and product recovery was conducted in the area of this UST from 1990 to 1998. MDNR issued a NFA letter in 2002. Closure certification for these permitted tanks was not submitted.
2A	9	Waste Nitric and Hydrofluoric Acid Solution Storage, AST Tanks H1, H2, H3, H4, H5, and H6	52	Closure certification for the permitted ASTs was accepted by MDNR in 1993. The tanks were removed.
	15	Waste Jet Fuel Storage Tank, Ramp Station 1 and 2	45K	The UST was removed in 1993. Ground water monitoring and product recovery was conducted in the area of this UST from 1990 to 1998. MDNR issued a NFA letter in 2002. Closure certification for these permitted tanks was not submitted.
	27	Waste Nitric and Hydrofluoric Acid Scrubber Saddles Drums Storage	52	The drums of non-hazardous waste scrubber saddles were removed for disposal in 1993.
2B	1	Waste Sodium Hydroxide Storage, AST Tanks H19 and H 20	52	Closure certification of the permitted ASTs was accepted by MDNR in 2003. The tanks were removed.
	2	Waste Nitric and Hydrofluoric Acid Solution Storage, AST Tanks H12, H13, and H14	52	Closure certification of the permitted ASTs was accepted by MDNR in 2003. The tanks were removed.
	16	Methyl Ethyl Ketone (MEK)/Methyl Isobutyl Ketone (MIBK) Recovery Unit	48	The recovery unit was removed in 1995.
	17	Perchloroethylene (PCE) Recovery Unit	51	Operation of the unit ceased in 1998 and the equipment was removed. Building 51 was demolished in 2004.
	25	Less-Than-90-Day Storage Area	51	Storage of waste was discontinued in 1998. The prefabricated storage structure was relocated to Tract II.

Table 1-6
Summary of Solid Waste Management Units (SWMUs)
Boeing Tract 1, Hazelwood, Missouri

Area/ Sub-area	Unit	Description	Building	Current Status
3D	22	Paint Booth Satellite Accumulation Drum	2	Interim action as required under the corrective action conditions of the hazardous waste facility permit was conducted in 1997. Boeing operation of this area ceased in 2001.
3E	24	Less-Than-90-Day Storage Area	2	Waste storage was discontinued at this area in 2001.
4	10	Current Waste Oil AST	5	The tank was removed and replaced with a 375-gallon AST located inside of Building 5. Interim measures as required by the corrective action conditions of the hazardous waste facility permit were conducted in 1997. Building 5 was vacated and demolished in 2006.
	11	Former Waste Oil UST	6	The UST was removed in 1988 and closure certification of the permitted tank was accepted by MDNR in 1993.
	28	Leaking Transformer	6	The transformer was decommissioned and removed and Interim action, as required under the corrective action conditions of the hazardous waste facility permit, was conducted in 1997.
5	3*	Wastewater Sludge Collection and Holding Tank	14	Tank is currently in service. The tank was included in the original hazardous waste permit even though it is exempt under the waste water treatment exemption. Sampling was conducted in 1994 and 1995 to remove the tank from permitted status. The closure certification was accepted by MDNR in 2001. The MDNR letter states that "a deed notice and institutional controls are to be put in place as part of the final remedy under site-wide corrective action".
	21*	Industrial Wastewater Treatment Plant Tanks, S-1, S-2, S-3, S-4, E-1, E-2, and E-3	14	The wastewater treatment facility and tanks are still in service. Rinse water from chemical processing is received at the facility from Boeing Tract II and GKN. Tanks S-2 and E-3 were lined in 2008.
6A	29	Waste Ferracoat, Methyl Ethyl Ketone, and Trichloroethylene Drum Storage	29A	Waste storage was discontinued at this area in 2000.

Table 1-6
Summary of Solid Waste Management Units (SWMUs)
Boeing Tract 1, Hazelwood, Missouri

Area/ Sub-area	Unit	Description	Building	Current Status
6B	4	Leaked or Spilled Jet Aircraft Fuel Storage Tank	28	Closure certification of the permitted UST was accepted by MDNR in 1995. The tank was removed in 2000.
	5	Current Reactive Cyanide and Sulfide-Bearing Waste Storage, Area 2	22	The prefabricated storage building was relocated to Tract II in 2000.
	6	Former Reactive Cyanide and Sulfide-Bearing Waste Storage, Area 2	22	All waste was removed and the area decontaminated in 2000. Closure certification of the permitted area was submitted to MDNR in 2000. The storage structure still exists on GKN property.
	8	Scrap Dock Shelter, Area 1	39	All waste was removed and the area decontaminated in 2000. Closure certification of the permitted area was submitted to MDNR in 2000. The storage structure still exists on GKN property.
	31	Maintenance Shop Waste Oil Tank	22	The tank was removed in 1996 and replaced with a 350-gallon AST located inside of a prefabricated metal storage structure equipped with spill containment. Building 22, which was leased by Boeing from GKN, was vacated in March of 2009. The tank and storage structure was relocated to Boeing Tract II.
	32	Polychlorinated Biphenyls (PCB) Storage Area	39	Use of the prefabricated storage building was discontinued in 2000 and the structure was decontaminated in 2001.
6C	18	Methyl Ethyl Ketone/Methyl Isobutyl Ketone Recovery Unit	27	The recovery unit was removed in 1995.
	30	Chemical Etching Spill Containment Area	27	A new tank line and containment system was installed in 2000. GKN continues to operate the chemical process tank line.
9	7	Explosive Waste Storage, Area 3	10	Closure certification of the permitted storage area was accepted by MDNR in 1995. The building still exists on Airport property.
	19	Drum Storage Areas and Related Satellite Accumulation Areas	Numerous	Accumulation and storage of waste was discontinued with the sale of the property to the Airport and GKN in 2000 and 2001.
	20	Paints Solids Satellite Accumulation Areas	Numerous	Accumulation and storage of waste was discontinued with the sale of the property to the Airport and GKN in 2000 and 2001.

Notes:

*: Currently active

AST: Above ground storage tank

UST: Underground storage tank

HH: Hush Houses

SOB45: South of Building 45

Table 1-7
Summary of Underground Storage Tanks (USTs)
Boeing Tract 1, Hazelwood, Missouri

Number	Building	Area/ Sub-area	DNR Tank Registration	Regulated	Volume (gals)	Contents	Construction Materials	Year Installed	Status in 2004	Leak Detection	Remedial Actions
B1	Bldg 41	3A	N/A	Yes	4,000	T-979 Solvent	Single Wall Steel	1947	Removed 1981/not replaced	N/A	Excavated
B2	Bldg 41	3A	N/A	Yes	4,000	Lacquer Thinner	Single Wall Steel	1947	Removed 1981/not replaced	N/A	Excavated
B3	Bldg 41	3A	N/A	Yes	8,000	Aviation Gas	Single Wall Steel	1947	Removed 1981/replaced	N/A	Excavated
B4	Bldg 41	3A	N/A	Yes	8,000	Gasoline	Single Wall Steel	1947	Removed 1981/replaced	N/A	Excavated
B5	Bldg 41	3A	N/A	Yes	4,000	JP-5	Single Wall Steel	1981	Removed 1989/replaced by F41	N/A	Excavated
B6	Bldg 41	3A	N/A	No	15,000	JP-4	Single Wall Steel	1947	Removed 1957/replaced	N/A	Excavated
B7	Bldg 41	3A	N/A	No	15,000	JP-4	Single Wall Steel	1947	Removed 1957/replaced	N/A	Excavated
B8	Bldg 41	3A	N/A	Yes	15,000	JP-4	Single Wall Steel	1948	Removed 1989/replaced by A41	N/A	Excavated
B9	Bldg 41	3A	N/A	Yes	15,000	JP-4	Single Wall Steel	1948	Removed 1989/replaced by B41	N/A	Excavated
B10	Bldg 41	3A	N/A	Yes	15,000	JP-4	Single Wall Steel	1957	Removed 1989/replaced by C41	N/A	Excavated
B11	Bldg 41	3A	N/A	Yes	15,000	JP-4	Single Wall Steel	1957	Removed 1989/replaced by D41	N/A	Excavated
B12	Bldg 41	3A	N/A	Yes	8,000	Gasoline	Fiberglass Reinforced Plastic	1981	Removed 1989/replaced by E41	N/A	Excavated
B13	Bldg 41	3A	N/A	Yes	8,000	JP-5	Fiberglass Reinforced Plastic	1981	Removed 1989/replaced by F41	Inventory Stick	Excavated
B14	Flight Operations/A-41	3A	8027	No/Exempt	30,000	Jet Fuel	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None
B15	Flight Operations/B-41	3A	8027	No/Exempt	30,000	Jet Fuel	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None
B16	Flight Operations/C-41	3A	8027	No/Exempt	30,000	Jet Fuel	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None

Table 1-7
Summary of Underground Storage Tanks (USTs)
Boeing Tract 1, Hazelwood, Missouri

Number	Building	Area/ Sub-area	DNR Tank Registration	Regulated	Volume (gals)	Contents	Construction Materials	Year Installed	Status in 2004	Leak Detection	Remedial Actions
B17	Flight Operations/D-41	3A	8027	No/Exempt	30,000	Jet Fuel	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None
B18	Company Vehicles/E-41	3A	8027	Yes	8,000	Gasoline	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None
B19	Flight Operations/F-41	3A	8027	No/Exempt	8,000	Water	Double Wall Fiberglass	1989	Removed 2005	Interstitial Alarm	None
B20	Bldg 1	3E	N/A	No	500	Gasoline	Single Wall Steel	1956	Removed 1961/not replaced	N/A	Excavated
B21	Bldg 1	3E	N/A	No	500	Gasoline	Single Wall Steel	1961	Removed 1972/not replaced	N/A	Excavated
B22	Bldg 1	3G	8021	Yes	6,000	Diesel	Single Wall Steel	1972	Removed 1980/not replaced	N/A	Excavated
B23	Bldg 1	3G	8021	Yes	5,000	Gasoline	Single Wall Steel Relined in 1979	1941	Removed 1989/not replaced	Inventory Control	Excavated
B24	Bldg 2	3E	N/A	Yes	1,000	Gasoline/Diesel	Single Wall Coated Tar Epoxy Steel	1942	Removed 1989/not replaced	N/A	Excavated
B25	Bldg 45	2C	N/A	Yes	335	Diesel	Single Wall Steel	1983	Removed 1987/not replaced	N/A	Excavated
B26	Bldg 45C/45D (Site #4)	1	N/A	Yes	3,380	Waste JP-4	Single Wall Steel	1983	Removed 1983/not replaced	N/A	Excavated
B27	Bldg 45C/45D (Site #4)	1	N/A	Yes	3,380	Waste JP-4	Fiberglass Reinforced Plastic	1983	Removed 1989/not replaced	Inventory Stick	Excavated
B28	Bldg 45E	1	N/A	Yes	2,130	Waste JP-4	Fiberglass Reinforced Plastic	1978	Removed 1990/not replaced	Inventory Stick	Excavated
B29		1	N/A	Yes	2,000	Waste JP-4	Single Wall Steel	1977	Removed 1992/Not Replaced	Inventory Stick	Excavated/ Recovery Wells with closure 2002
B30		1	N/A	Yes	2,000	Waste JP-4	Single Wall Steel	1983	Removed 1992/Not Replaced	Inventory Stick	Excavated/ Recovery Wells with closure 2002

**Table 1-7
Summary of Underground Storage Tanks (USTs)
Boeing Tract 1, Hazelwood, Missouri**

Number	Building	Area/ Sub-area	DNR Tank Registration	Regulated	Volume (gals)	Contents	Construction Materials	Year Installed	Status in 2004	Leak Detection	Remedial Actions
B31	Bldg 45K (Site #1)	2A	N/A	Yes	4,380	Waste JP-4	Fiberglass Reinforced Plastic	1983	Removed 1993/Not Replaced	Inventory Stick	Excavated/Recovery Wells with closure 1999
B32	Bldg 51	2A	N/A	Yes	6,000	Solvents	Single Wall Steel	1977	Removed 1986/not replaced	Inventory Stick	Excavated
B33	Bldg 43 Fuel Farm	3C	UT0005886	Yes	20,000	Jet Fuel	Single Wall Steel	1957	Removed 1991/Not Replaced	Inventory Stick	Excavated total site of 799 cu yds
B34	Bldg 43 Fuel Farm	3C	UT0005886	Yes	20,000	Jet Fuel	Single Wall Steel	1957	Removed 1991/Not Replaced	Inventory Stick	Excavated total site of 799 cu yds
B35	Bldg 43 Fuel Farm	3C	UT0005886	Yes	20,000	Jet Fuel	Single Wall Steel	1957	Removed 1991/Not Replaced	Inventory Stick	Excavated total site of 799 cu yds
B36	Bldg 43 Fuel Farm	3C	UT0005886	Yes	20,000	Jet Fuel	Single Wall Steel	1957	Removed 1991/Not Replaced	Inventory Stick	Excavated total site of 799 cu yds
B37	Bldg 43 Fuel Farm	3C	UT0005886	Yes	20,000	Jet Fuel	Single Wall Steel	1957	Removed 1991/Not Replaced	Inventory Stick	Excavated total site of 799 cu yds
B38	Bldg 6 (Boeing)	4	N/A	No/Exempt	20,000	Fuel Oil	Double Wall Steel/Plastic Coated	1989	Removed 2007	Inventory Control	No action
B39	Bldg 6 (Boeing)	4	N/A	No/Exempt	20,000	Fuel Oil	Double Wall Steel/Plastic Coated	1989	Removed 2007	Inventory Control	No action
B40	Bldg 14 (Boeing)	5	N/A	No/Exempt	120,000	Waste Water Treatment Sludge	Concrete with Rubber Liner	1941	Current	Visual Inspection	No action
B41	Bldg 5	3H	N/A	No	15,000	Fuel Oil	Single Wall Steel	1941	Removed 1988	Visual Inspection	Excavated
B42	Bldg 5	3H	N/A	No	15,000	Fuel Oil	Single Wall Steel	1941	Removed 1988	Visual Inspection	Excavated
B43	Bldg 5	3H	N/A	No	6,000	Fuel Oil	Single Wall Steel	1941	Removed 1988	Visual Inspection	Excavated
B44	Bldg 6	4	N/A	Yes	1,000	Waste Oil	Single Wall Steel	1970	Removed 1988	Visual Inspection	Excavated
B45	Bldg 221	8C	N/A	No	5,000	Fuel Oil	Single Wall Steel	1954	Removed 1990/Not Replaced	Visual Inspection	Excavated
B46	Bldg 33	7	N/A	Yes	3,000	Diesel	Single Wall Steel	1960	Removed 1990/Not Replaced	Visual Inspection	Excavated
B47	Bldg 33	7	N/A	No	20,000	Fuel Oil	Single Wall Steel	1960	Removed 1990/Not Replaced	Visual Inspection	Excavated

Table 1-7
Summary of Underground Storage Tanks (USTs)
Boeing Tract 1, Hazelwood, Missouri

Number	Building	Area/ Sub-area	DNR Tank Registration	Regulated	Volume (gals)	Contents	Construction Materials	Year Installed	Status in 2004	Leak Detection	Remedial Actions
B48	Bldg 32	7	N/A	Yes	500	Gasoline	Single Wall Steel	1975	Removed 1990/Not Replaced	Visual Inspection	Excavated
B49	Bldg 33	7	N/A	No	10,000	Fuel Oil	Single Wall Steel	1955	Removed 1990/Not Replaced	Visual Inspection	Excavated
B50	Bldg 34	7	N/A	Yes	850	Diesel	Single Wall Steel	1961	Removed 1990/Not Replaced	Visual Inspection	Excavated
B51	Bldg 34	7	N/A	No	10,000	Fuel Oil	Single Wall Steel	1961	Removed 1990/Not Replaced	Visual Inspection	Excavated
B52	Bldg 22	6B	N/A	Yes	5,000	Leaded Gasoline	Single Wall Steel	1942	Removed 1961 & Replaced	Visual Inspection	Excavated
B53	Bldg 22	6B	N/A	Yes	7,520	Leaded Gasoline	Single Wall Steel	1961	Removed 1989 & Replaced	Inventory Control	Excavated
B54	Bldg 22	6B	UT0008016	Yes	8,000	Unleaded Gasoline	Double Wall Fiberglass	1989	Retrofitted in 1995	Inventory Control	No action
B55	Bldg 22	6B	UT0008016	Yes	10,000	Unleaded Gasoline	Single Wall Fiberglass	1981	Removed in 1995 & Replaced	Inventory Control	Excavated
B56	Bldg 22	6B	UT0008016	Yes	10,000	Unleaded Gasoline	Double Wall Plastic Coated Steel	1995	Removed 2010	Interstitial Alarm	No action
B57	Bldg 22	6B	UT0008016	Yes	10,000	Diesel	Single Wall Fiberglass	1981	Removed 2010	Inventory Control	Excavated
B58	Bldg 22	6B	UT0008016	Yes	10,000	Diesel	Double Wall Plastic Coated Steel	1995	Removed 2010	Interstitial Alarm	No action
B59	Bldg 25	6C	UT0005954	Yes	8,000	Methyl Alcohol	Single Wall Steel	1984	Removed in 1995/Not Replaced	Inventory Control	Excavated
B60	Bldg 28	6B	UT0008017	Yes	5,000	Jet Fuel	Single Wall Steel	1955	Removed in 1989 & Replaced	Inventory Control	Excavated
B61	Bldg 28	6B	UT0008017	Yes	5,000	Jet Fuel	Single Wall Steel	1955	Removed in 1989 & Replaced	Inventory Control	Excavated
B62	Bldg 28	6B	UT0008017	Yes	5,000	Waste Jet Fuel	Single Wall Steel	1953	Removed in 1989 & Replaced	Inventory Control	Excavated
B63	Bldg 28	6B	UT0008017	Yes	5,000	Jet Fuel	Double Wall Steel	1989	Removed in 2000/Not Replaced	Inventory Control	Excavated
B64	Bldg 28	6B	UT0008017	Yes	5,000	Jet Fuel	Double Wall Steel	1989	Removed in 2000/Not Replaced	Inventory Control	Excavated

Table 1-7
Summary of Underground Storage Tanks (USTs)
Boeing Tract 1, Hazelwood, Missouri

Number	Building	Area/ Sub-area	DNR Tank Registration	Regulated	Volume (gals)	Contents	Construction Materials	Year Installed	Status in 2004	Leak Detection	Remedial Actions
B65	Bldg 28	6B	UT0008017	Yes	5,000	Waste Jet Fuel	Double Wall Steel	1989	Removed in 2000/Not Replaced	Inventory Control	Excavated/RCRA Corrective Action
B66	Bldg 29	6B	UT0008019	Yes	4,000	Hydraulic Oil	Single Wall Fiberglass	1980	Removed in 1994/Not Replaced	Visual Inspection	Excavated
B67	Bldg 20	6C	N/A	No	250	Fuel Oil	Single Wall Steel	1943	Removed in 1999/Not Replaced	Visual Inspection	Excavated
B68	Bldg 42	3B	N/A	No	Unknown	Aviation Gasoline	Single Wall Fiberglass	Unknown	Removed Date Unknown/Not Replaced	Visual Inspection	Excavated

Notes:
DNR: Department of Natural Resources
Bldg: Building
gals: Gallons
cu yds: Cubic yards
N/A: Not applicable

Table 1-8
Inventory of Monitoring Wells and Piezometers
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Monitoring Well/ Piezometer	Diameter (in.)	Screened Interval (ft bgs)	Total Depth (ft)	Installation Date	Groundwater Data Available	Current Status
Area 1 Runway Protection Zone							
1	MW-A1	2	5-15	15	7/12/1989	Yes	Active
1	MW-A14	2	4.5-14.5	15	8/3/1989	No	Damaged, obstruction
1	MW-A17	2	4.5-14.5	15	8/4/1989	Yes	Active
1	MW-A18	2	4.5-14.5	15	8/4/1989	Yes	Active
1	MW-A2	2	4-14.5	17	7/12/1989	No	Abandoned
1	MW-A21	2	1.5-11.5	15	8/8/1989	No	Abandoned
1	MW-A22	2	4.5-14.5	15	10/30/1989	Yes	Active
1	MW-A23	2	2.7-12.7	15	10/30/1989	Yes	Active
1	MW-A24	2	3-13	15	10/31/1989	No	Active
1	MW-A25	2	3-13	15	11/1/1989	Yes	Active
1	MW-A26	2	4-14	15	11/1/1989	Yes	Active
1	MW-A27	2	3.7-13.7	15	11/1/1989	Yes	Active
1	MW-A28	2	4.5-14.5	15	11/1/1989	Yes	Active
1	MW-A29	2	4.5-14.5	15	11/1/1989	Yes	Active
1	MW-A3	2	5-15	15	7/13/1989	Yes	Active
1	MW-A5	2	2-12.5	15	7/18/1989	No	Damaged, obstruction
1	B45CMW-3A	4	NA	14.4*	1995	Yes	Abandoned
1	B45CMW-3B	4	NA	14.5*	1995	Yes	Abandoned
1	MW-A15	2	4.5-14.5	15	8/3/1989	Yes	Abandoned
Area 2 Demolished Area							
2A	MW-A6	2	2.5-12.5	15	7/14/1989	Yes	Active
2A	MW-A8	2	2.5-12.5	15	7/17/1989	Yes	Active
2A	MW-A7	2	2.5-12.5	15	7/14/1989	No	Abandoned
2A	MW-A16	2	2.5-12.5	13	8/3/1989	No	Abandoned
2B	B48N1	1	2.5-12.5	12.5	11/22/2002	Yes	Active
2B	MW-5I	2	32.0-42.0	45	4/21/1998	Yes	Active
2B	MW-6S	2	5.0-15.0	15	4/20/1998	Yes	Active
2B	MW-7S	4	3.0-15.0	16	12/5/2000	Yes	Destroyed
2B	MW-8I	2	32.0-40.0	40	12/18/2000	Yes	Active
2B	MW-8S	2	8.0-16.0	16	12/18/2000	Yes	Active
2B	MW-9S	2	6.0-16.0	16	12/20/2000	Yes	Active

Table 1-8
Inventory of Monitoring Wells and Piezometers
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Monitoring Well/ Piezometer	Diameter (in.)	Screened Interval (ft bgs)	Total Depth (ft)	Installation Date	Groundwater Data Available	Current Status
2B	MW-10S	2	5.0-15.0	16	12/12/2000	Yes	Active
2B	MW-11D	2	64.0-74.0	75.25	12/18/2000	Yes	Active
2B	MW-11I	2	32.0-40.0	40	12/13/2000	Yes	Active
2B	MW-11S	2	6.5-16.5	16.5	12/12/2000	Yes	Active
2B	SWMU17-OB-1	4	0-11.75	11.75	11/2005	Yes	Active
2B	TP-3	1	6-12.5	12.5	2/5/1998	Yes	Active
2B	TP-4	1	9-14.6	14.6	2/6/1998	Yes	Active
2B	TP-6	1	6.0-16.0	16	9/5/2001	Yes	Active
2B	B51I1					Yes	Destroyed
2B	SB18			16	12/5/2000	Yes	Destroyed
2B	TP-1	1	11-17	17	2/4/1998	Yes	Destroyed
2B	TP-2	1	6.0-12.5	12.5	2/4/1998	Yes	Destroyed
2B	TP-5	1	6.0-16.0	16	2/4/2000	Yes	Destroyed
2C	MW-A9	2	4.5-14.5	15	7/17/1989	No	Abandoned
2C	MW-A10	2	4.5-14.5	15	7/18/1989	No	Abandoned
2C	MW-A11	2	8.5-18.5	19	7/19/1989	No	Abandoned
2C	MW-A12	2	4.5-14.5	15	8/2/1989	Yes	Active
2C	MW-A13	2	4.5-14.5	15	8/2/1989	Yes	Active
2C	MW-A20	2	8.5-18.5	19	8/7/1989	No	Abandoned
Area 3 Retained Area							
3A	B42N6	0.75	5-15	15	12/13/2005	Yes	Active
3A	B42N7	1	5-15	15	10/13/2005	Yes	Active
3A	B42N8	1	3-13	13	11/4/2005	Yes	Active
3A	B41MW-4	2	2-12	12	10/26/1988	Yes	Abandoned
3A	B41MW-18	2	2-12	12	11/8/1988	Yes	Active
3A	B42N5			16	7/23/2003	Yes	Destroyed
3C	MW-A4	2	2-12	12	7/13/1989	Yes	Active
3D	B41MW-5	2	2-12	12	10/26/1988	Yes	Active
3D	B41MW-7	2	2-12	12	10/28/1988	Yes	Active
3D	B41S5D	0.75	56.29-66.29	66.29	7/24/2003	Yes	Active
3D	B41E2D	0.75	58.87-68.87	68.87	7/23/2003	No	Active
3E	B2E2			16	7/24/2003	Yes	Destroyed

Table 1-8
Inventory of Monitoring Wells and Piezometers
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Monitoring Well/ Piezometer	Diameter (in.)	Screened Interval (ft bgs)	Total Depth (ft)	Installation Date	Groundwater Data Available	Current Status
3E	B2E3	1	5-15	15	10/13/2005	Yes	Active
3E	B2E4	1	5-15	15	10/13/2005	No	Active
3E	B2E5	1	3-13	13	11/4/2005	Yes	Active
3H	B4MW-9	2	10-19.8	19.8	11/2/1988	Yes	Active
3H	B4MW-10	2	2-12	12	11/22/1988	Yes	Active
3H	B5MW-22	2	5-14.6	14.6	11/10/1988	Yes	Active
Area 6 GKN Facility							
6A	MW1	2	10-20	20	7/17/2000	Yes	Active
6B	B27W3D	0.5	21-26	26	9/19/2000	Yes	Active
6B	B28MW1	2	2-12	12	10/25/1988	Yes	Active
6B	B28MW-15	2	2-12	12	11/8/1988	No	Abandoned
6B	B28MW-16	2	2-12	12	11/8/1988	No	Abandoned
6B	B28MW-1A	2	3.3-13.3	13.3	10/24/1988	No	Abandoned
6B	B28MW2	2	2-12	12	11/7/1988	Yes	Active
6B	B28MW3	2	2-12	12	11/7/1988	Yes	Active
6B	B28MW4	2	10.6-15.6	15.6	8/1/1988	Yes	Active
6B	MW3	2	9.7-19.7	19.7	7/19/2000	Yes	Active
6B	MW3A	2	5.0-20.0	20	6/10/2002	Yes	Active
6B	MW3B	2	5.0-20.0	20.0	6/10/2002	Yes	Active
6B	MW7	2	6.9-11.9	14.4	7/19/2000	Yes	Active
6B	MW9S	2	8.0-18.0	73.5	9/18/2000	Yes	Active
6B	RC2			16	7/25/2000	Yes	Destroyed
6B	RC6D	0.5	16-21	21	9/18/2000	Yes	Active
6B	RC8D	0.5	19-24	24	9/18/2000	Yes	Active
6B	RC9	1	6-16	16	11/13/2000	Yes	Destroyed
6B	RC13	1	5-15	15	7/5/2005	Yes	Active
6B	RC14	1	3-13	13	7/5/2005	Yes	Active
6B	RC15	1	4.5-14.5	14.5	9/29/2005	Yes	Active
6B	MW9D	2	62.5-72.5	72.5	9/22/2000	No	Abandoned
6C	B25MW1	2	10.7-15.7	15.7	8/1/1988	Yes	Active
6C	B25MW2	2	10.5-15.5	15.5	8/1/1988	No	Active
6C	B25MW3	2	NA	60	NA	No	Abandoned

Table 1-8
Inventory of Monitoring Wells and Piezometers
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Monitoring Well/ Piezometer	Diameter (in.)	Screened Interval (ft bgs)	Total Depth (ft)	Installation Date	Groundwater Data Available	Current Status
6C	MW5AD	2	68.4-78.4	78.5	9/25/2000	Yes	Active
6C	MW5AS	2	5.0-15.0	16.5	9/21/2000	Yes	Active
6C	MW5BS	2	6.15-16.15	16.5	11/22/2000	Yes	Active
6C	MW5CS	2	7.64-17.64	18.1	11/22/2000	Yes	Active
6C	MW5DS	2	7.08-17.08	17.5	11/22/2000	Yes	Active
6C	MW8	2	9.5-19.5	20	7/18/2000	Yes	Active
6C	MW8AD	2	70.5-80.5	81	9/21/2000	Yes	Active
6C	MW8AS	2	6.5-16.5	16.5	9/21/2000	Yes	Active
6C	B25MW4	2	10.6-15.6	15.6	8/1/1988	Yes	Abandoned
6D	MW6	2	8.0-23.0	23	7/19/2000	Yes	Active
6D	MW6D	2	68.0-78.0	78	9/23/2000	Yes	Active
Area 7 Engineering Campus							
7	MW2	2	8.0-18.0	19.1	7/17/2000	Yes	Active
Area 8 Office Complex North							
8A	MW10D	2	69.5-79.5	79.5	9/22/2000	Yes	Active
8A	MW10S	2	8.0-18.0	79.5	9/19/2000	Yes	Active
8B	MW4	2	9.5-19.5	19.5	7/18/2000	Yes	Active
8B	B220N1			8	7/24/2000	Yes	Destroyed
8B	B220N4	1	3-13	13	7/5/2005	Yes	Active
8B	B220N5	1	3-13	13	7/5/2005	Yes	Active
8B	B220N6	1	3-13	13	9/30/2005	Yes	Active

Notes:

NA: Not available

ft bgs: Feet below ground surface

* Assumed total depth is equal to known depth to bottom of screened interval

Table 2-1
Summary of Cumulative Risks*
Boeing Tract 1, Hazelwood, Missouri

Area	Non-residential Worker		Construction Worker	
	IELCR	HI	IELCR	HI
Area 1	N/A	N/A	3.76E-07	0.16
Sub-area 2A	3.63E-08	0.052	5.57E-07	0.19
Sub-area 2B	7.35E-06	0.72	3.35E-04	4.6
Sub-area 2C	1.21E-08	0.95	6.05E-08	0.15
Sub-area 3A	1.44E-08	0.017	6.05E-08	0.35
Sub-area 3B	2.01E-09	0.31	1.76E-09	0.039
Sub-area 3C	1.20E-08	0.033	5.88E-08	0.047
Sub-area 3D	1.25E-08	0.075	2.71E-07	0.066
Sub-area 3E	7.48E-09	0.048	8.67E-10	0.72
Sub-area 3F	NA	0.86	NA	0.059
Sub-area 3G	3.61E-08	0.011	2.37E-07	0.33
Sub-area 3H	NA	0.70	2.69E-12	0.040
Area 4	1.10E-10	0.47	5.40E-06	0.042
Area 5	NA	0.00053	8.17E-08	0.022
Sub-area 6A	6.73E-11	0.054	6.85E-08	0.014
Sub-area 6B	1.95E-07	0.0063	5.07E-05	0.90
Sub-area 6C	2.33E-08	0.0038	1.18E-07	0.21
Sub-area 6D	3.08E-09	0.00014	2.95E-07	0.018
Area 7	N/A	N/A	N/A	N/A
Sub-area 8A	9.39E-09	0.00004	1.35E-07	0.020
Sub-area 8B	NA	0.0029	5.59E-10	0.00023
Sub-area 8C	NA	0.064	2.65E-11	0.017
Area 9	1.79E-11	0.19	9.03E-11	0.031

Notes:

Risk in bold exceeds the cumulative acceptable target risk levels.

IELCR: Individual excess lifetime cancer risk

HI: Hazard index

NA: Not available

N/A: Not applicable

Area 7 - No risk calculation was performed since there are no industrial activities.

* Risks re-calculated, refer Appendix C

Table 2-2
Summary of Areas and Issues
Boeing Tract 1, Hazelwood, Missouri

Area	Risk ¹	LNAPL ²	Drinking Water Standards ³	Plume Stability ⁴
Area 1		X	X	
Sub-area 2A		X	X	
Sub-area 2B	X	X	X	X
Sub-area 2C	X	X	X	X
Sub-area 3A			X	X
Sub-area 3B				X
Sub-area 3C		X		
Sub-area 3D			X	
Sub-area 3E				
Sub-area 3F				X
Sub-area 3G				X
Sub-area 3H	X		X	X
Area 4				X
Area 5				
Sub-area 6A			X	
Sub-area 6B	X		X	X
Sub-area 6C			X	X
Sub-area 6D			X	
Area 7				
Sub-area 8A			X	
Sub-area 8B			X	
Sub-area 8C				
Area 9				X

Notes:

- 1: For further discussion, refer to Section 3.0
- 2: For further discussion, refer to Section 4.0
- 3: For further discussion, refer to Section 5.0
- 4: For further discussion, refer to Section 6.0

Table 4-1
LNAPL Summary (1990-2011)
Boeing Tract 1, Hazelwood, Missouri

Well ID	Installation Date	LNAPL		Last Gauging Data	Last Date of LNAPL Observance	Last Observed LNAPL Thickness (ft)
		at Well Installation	Since 92			
Area 1 (Runway Protection Zone)						
MW-A1	7/12/1989	Yes	Yes	6/15/2011	11/3/2010	Sheen
MW-A2*	7/12/1989	Sheen	No	Abandoned		
MW-A3	7/13/1989	Yes	Yes	6/15/2011	11/3/2010	Sheen
MW-A5	7/18/1989	Yes	No	Well damaged (obstruction)		
MW-A14	8/3/1989	Yes	No	Well damaged (obstruction)		
MW-A15	8/3/1989	Yes	No	11/3/2010	--	--
MW-A18	8/4/1989	Sheen	No	Gauging data not available		
MW-A21*	8/8/1989	Sheen	No	Abandoned		
MW-A22	10/30/1989	Yes	No	11/3/2010	--	--
MW-A23	10/30/1989	Yes	No	11/3/2010	--	--
MW-A25	11/1/1989	No	Yes	6/15/2011	11/3/2010	Sheen
MW-A26	11/1/1989	No	Yes	6/15/2011	11/3/2010	Sheen
MW-A27	11/1/1989	No	Yes	6/15/2011	4/13/2010	0.005
MW-A28	11/1/1989	Yes	No	11/3/2010	--	--
B45CMW-3A*	1995	Yes	Yes	3/1/2004	3/1/2004	Sheen
B45CMW-3B*	1995	Yes	Yes	11/18/1998	11/18/1998	Sheen
Area 2 (Demolished Area)						
MW-A6	7/14/1989	No	Yes	6/15/2011	4/13/2010	Sheen
MW-A9*	7/17/1989	Yes	No data	Abandoned		
MW-A10*	7/18/1989	No	Yes	3/31/1997	12/26/1996	Sheen
MW-A11*	7/19/1989	Yes	Yes	Abandoned		
MW-A12	8/2/1989	Yes	Yes	11/1/2010	1/14/1990	1.13
MW-A13	8/2/1989	Yes	Yes	6/15/2011	11/18/2008	Sheen
MW-A19	8/7/1989	Yes	No	12/27/1994	2/1/1990	Sheen
MW-A20*	8/7/1989	No	Yes	Abandoned		
MW-5I	4/21/1998	No	Yes	9/29/2011	4/13/2010	Sheen
MW-9S	12/20/2000	Yes	Yes	6/15/2011	6/15/2011	0.03
MW-10S	12/12/2000	Yes	Yes	6/15/2011	6/15/2011	0.06
TP-3	2/5/1998	No	Yes	6/15/2011	11/18/2008	0.01
TP-4	2/6/1998	No	Yes	6/15/2011	11/18/2008	0.01
TP-6	9/5/2001	Yes	Yes	6/15/2011	4/13/2010	Sheen
Area 3 (Retained Area)						
MW-A4	7/13/1989	No	Yes	6/15/2011	4/13/2010	Sheen
Area 6 (GKN Area)						
RC2*	7/25/2000	Yes	Yes	7/25/2004	7/25/2001	Sheen

Notes

None of the other wells in Area 6 had LNAPL and LNAPL was not observed in Areas 4,5,7,8,9

--: LNAPL was observed only at installation MW-A19 could not be identified, gauging data not available

*: Abandoned

Table 4-2
LNAPL Data (2008-2011)
Boeing Tract 1, Hazelwood, Missouri

Well ID	Area / Sub-area	November 2008			April 2010 [#]			October-November 2010			June 2011		
		Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)
Area 1 (Runway Protection Zone)													
MW-A1	1	11/18/2008	0.01	4.84	4/13/2010	Sheen	4.88	11/3/2010	Sheen	5.26	6/15/2011	--	4.2
MW-A3	1	11/18/2008	0.01	3.87	4/13/2010	0.01	4.06	11/3/2010	Sheen	4.28	6/15/2011	--	2.94
MW-A25	1	11/17/2008	--	3.79	4/3/2010	--	3.95	11/3/2010	Sheen	4.36	6/15/2011	--	3.29
MW-A26	1	11/17/2008	--	5.45	4/3/2010	--	5.27	11/3/2010	Sheen	6.21	6/15/2011	--	4.37
MW-A27	1	11/17/2008	--	3.73	4/13/2010	0.005 [#]	3.63	11/3/2010	--	5.02	6/15/2011	--	3.6
Area 2 (Demolished Area)													
MW-A6*	2A	11/18/2008	--	3.95	4/13/2010	Sheen	4.83	10/29/2010	--	4.6	6/15/2011	--	4.32
MW-9S	2B	11/18/2008	0.01	6.47	4/13/2010	0.01	4.05	11/1/2010	0.10	4.12	6/15/2011	0.03	4.02
MW-10S	2B	11/18/2008	0.05	6.40	4/13/2010	0.01	6.11	10/29/2010	0.03	6.03	6/15/2011	0.06	6.14
MW-5I	2B	11/17/2008	--	6.90	4/13/2010	Sheen [#]	6.84	11/1/2010	--	6.8	6/15/2011	--	7.09
TP-3	2B	11/18/2008	0.01	5.47	4/13/2010	--	5.04	11/1/2010	--	6.01	6/15/2011	--	5.21
TP-4	2B	11/18/2008	0.01	3.88	4/13/2010	--	3.23	11/1/2010	--	4.19	6/15/2011	--	3.23
TP-6	2B	11/18/2008	--	5.34	4/13/2010	Sheen	4.85	10/29/2010	--	5.76	6/15/2011	--	5.01
MW-A13	2C	11/18/2008	Sheen	4.83	4/13/2010	--	5.18	11/1/2010	--	5.23	6/15/2011	--	4.48
Area 3 (Retained Area)													
MW-A4	3C	11/17/2008	--	9.38	4/13/2010	Sheen [#]	9.40	10/28/2010	--	8.15	6/15/2011	--	9.48

Notes:

--: LNAPL not observed

*: Previously labeled as MW-A16

#: LNAPL or sheen observed during gauging on April 3, 2010 and no measurable LNAPL or sheen was observed during sampling on April 29-May 3, 2010

ft: feet

btoc: below top of casing

Table 4-3
Groundwater Concentrations of Petroleum Related Chemicals in Wells with LNAPL in Area 1
Boeing Tract 1, Hazelwood, Missouri

Sample	Screening Value*	MW-A1	MW-A3	MW-A27	MW-A1	MW-A3	MW-A25
Date Collected	(µg/L)	11/19/2008		5/3/2010	11/4/2010		
TPH (8260/8270)							
TPH - GRO (C6 - C10) (8260)	18,100	230 J	< 500	< 500	NA	NA	NA
TPH-DRO (C10 - C21)	34,300	2,780	2,790	240 J	NA	NA	NA
TPH-ORO (C21 - C35)	31,800	556	493	< 300	NA	NA	NA
VOCs (8260)							
1,2,3-Trimethylbenzene	--	6.42	< 5	< 5	< 5	< 5	< 5
Isopropylbenzene	680	4.5 J	3.3 J	< 5	4.3 J	4.3 J	< 5
n-Butylbenzene	98.9	3 J	1.2 J	< 5	6.1	3.8 J	< 5
n-Propylbenzene	1,300	4.9 J	3.7 J	< 5	6.3	2.1 J	< 5
sec-Butylbenzene	106	4.1 J	2.1 J	< 5	4.8 J	3.6 J	< 5
tert-Butylbenzene	103	1 J	1 J	< 5	1.2 J	1.2 J	< 5

Notes:

NA: Not analyzed

J: analyte detected below reporting limit

Chemicals detected at least once are shown

--: Screening value not available

*: Screening values are MCLs or equivalent

Only petroleum based aromatic compounds are considered in this evaluation

Table 4-4
Groundwater Concentrations of Petroleum Related Chemicals in Wells with LNAPL in Area 2
Boeing Tract 1, Hazelwood, Missouri

Sample	Screening Value* (µg/L)	MW-9S	MW-10S	TP-3	TP-4	MW-A13
Date Collected		11/20/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008
Area ID		2B	2B	2B	2B	2C
TPH (8260/8270)						
TPH - GRO (C6 - C10)	18,100	< 500	< 500	< 500	645	< 500
TPH-DRO (C10 - C21)	34,300	762,000	1,030	1,450 S	280 J	1,110
TPH-ORO (C21 - C35)	31,800	< 60,000	424	535	210 J	460 J
VOCs (8260)						
Benzene	5	1.9 J	< 2	< 2	< 2	< 2
Isopropylbenzene	680	< 5	< 5	4.6 J	< 5	< 5
Methyl tert-butyl ether	12	< 2	< 2	< 2	1 J	< 2
Naphthalene	0.14	< 10	< 10	< 10	2.4 J	< 10
n-Butylbenzene	98.9	< 5	< 5	7.63	< 5	< 5
n-Propylbenzene	1,300	< 5	< 5	3.3 J	< 5	< 5
o-Xylene	1200	1.2 J	< 5	< 5	< 5	< 5
sec-Butylbenzene	106	< 5	< 5	4.9 J	< 5	< 5
Xylenes, Total	10,000	1.2 J	< 5	< 5	< 5	< 5

Notes:

J: analyte detected below reporting limit

Chemicals detected at least once are shown

Concentrations shown in bold exceed the screening value

*: Screening values are MCLs or equivalent

Table 5-1
Monitoring Wells and Groundwater Analytical Methods
Boeing Tract 1, Hazelwood, Missouri

Area / Sub-area	Monitoring Well	Shallow(S) Intermediate(I) Deep(D) Backfill(B) Wells	Monitor Well Diameter (inch)	Screened Interval (ft btoc)	Sampling Method SS-Snap Sampler or LF-Low Flow	Analytical Methods					Monitoring Use
						VOC	TPH-GRO	TPH-DRO	TPH-ORO	MNA Parameters	
Area 2: Demolished Area (15 wells)											
2B	MW-6S	S	2	5-15	SS	1				1	GWS/MNA
	MW-8I	I	2	32-40	SS	1				1	GWS/MNA
	MW-11S	S	2	6.5-16.5	SS	1				1	GWS/MNA
	MW-5I	I	2	32-42	SS	1				1	GWS/MNA
	MW-8S	S	2	8-16	SS	1				1	GWS/MNA
	MW-11I	I	2	32-42	SS	1				1	GWS/MNA
	MW-11D	D	2	64-74	SS	1					GWS
	MW-9S	S	2	6-16	LF*	1				1	GWS/MNA
	MW-10S	S	2	5-15	LF*	1				1	GWS/MNA
	B48N1	S	1	2-12.5	Peristaltic*	1				1	MNA
	TP-3	S	1	6-12.5	LF*	1				1	MNA
	TP-4	S	1	9-14.6	LF*	1				1	MNA
	TP-6	S	1	6-16	LF*	1				1	MNA
	SWMU17-OB-1	B	4	0-11.75	SS	1					GWS
2C	MW-A13	S	2	4.5-14.5	LF*	1	1	1	1		GWS
Area 3: Retained Area (4 wells)											
3A	B41MW-18	S	2	2-12	SS		1	1			GWS
	B42N6	S	1	5-15	Peristaltic*		1	1			GWS
3H	B4MW-9	S	2	10-19.8	SS	1	1	1	1		GWS
	B4MW-10	S	2	2-12	Peristaltic*	1	1	1	1		GWS

Table 5-1
Monitoring Wells and Groundwater Analytical Methods
Boeing Tract 1, Hazelwood, Missouri

Area / Sub-area	Monitoring Well	Shallow(S) Intermediate(I) Deep(D) Backfill(B) Wells	Monitor Well Diameter (inch)	Screened Interval (ft btoc)	Sampling Method SS-Snap Sampler or LF-Low Flow	Analytical Methods					Monitoring Use
						VOC	TPH-GRO	TPH-DRO	TPH-ORO	MNA Parameters	
Area 6: GKN Facility (15 wells)											
6B	B28MW3	S	2	2-12	SS	1	1	1	1		GWS
	MW7	S	2	7-11.9	SS	1	1	1	1		GWS
	B27W3D	S	0.5	21-26	Peristaltic*	1	1	1	1		GWS
	B28MW4	S	2	5.5-20.5	SS	1	1	1	1		GWS
	MW3	S	2	10-19.7	SS	1	1	1	1	1	GWS/MNA
	MW3A	S	2	5-20	SS	1				1	MNA
	MW3B	S	2	5-20	SS	1				1	MNA
	MW9S	S	2	8-18	SS	1	1	1	1	1	GWS/MNA
	RC6D	S	0.5	16-21	Peristaltic*	1				1	MNA
	RC8D	S	0.5	19-24	Peristaltic*	1				1	MNA
6C	MW5DS	S	2	7-17.08	SS				1		GWS
	MW8AS	S	2	6-16.5	SS				1		GWS
	MW8AD	D	2	70-80.5	SS				1		GWS
6D	MW6	S	2	8-23	SS	1					GWS
	MW6D	D	2	68-78	SS	1					GWS
Area 8: Office Complex North (2 wells)											
8A	MW10S	S	2	8-18	SS	1					GWS
	MW10D	D	2	69.5-79.5	SS	1					GWS
Total Samples						31	11	11	12	18	
QA/QC Samples											
Duplicates (1 per 20 samples)						3	1	1	1	1	
Equipment Blanks (1 per day)						10					
Trip Blanks (1 per shipment of VOC samples)						10					
Totals						54	12	12	13	19	

Notes:

Have Snap Samplers®

VOC / TPH-GRO: Volatile Organic Compounds & TPH-GRO (8260)

TPH-DRO / TPH-ORO: (8270)

Hg: Mercury (7470)

ft btoc: feet below top of casing

*: Snap sampler could not be installed due to small manway or small casing or occasional presence of LNAPL

GWS: Groundwater Stability

MNA: Monitored Natural Attenuation

MNA Parameters will vary and collected annually after the initial MNA event

Table 5-2
Natural Attenuation Analytical Methods, Data Uses, and Sampling and Handling Procedures
Boeing Tract 1, Hazelwood, Missouri

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation
Water	Aromatic and chlorinated hydrocarbons	SW8260A		Method of analysis for BTEX and chlorinated solvents/byproducts, which are the primary target analytes for monitoring natural attenuation; method can be extended to higher molecular weight alkyl-benzenes; trimethylbenzenes are used to monitor plume dilution if degradation is primarily anaerobic.	Initial MNA sampling and periodic thereafter	Collect water samples in a 40 mL VOA vial; cool to 4°C; add sulfuric acid to pH 2
Water	Oxygen	Dissolved oxygen meter calibrated in the field according to the supplier's specifications	Refer to method A4500 for a comparable laboratory procedure.	Concentrations less than 1 mg/L generally indicate an anaerobic pathway	Initial MNA sampling and periodic thereafter	Measure dissolved oxygen onsite using a flow-through cell
Water	Nitrate	IC method E300		Substrate for microbial respiration if oxygen is depleted	Initial MNA sampling and periodic thereafter	Collect at least 40 mL of water in a glass or plastic container; add H ₂ SO ₄ to pH less than 2, keep cool
Water	Iron (II) (Fe ²⁺)	Colorimetric Hach Method # 8146	Filter if turbid.	May indicate an anaerobic degradation process due to depletion of oxygen, nitrate, and manganese	Initial MNA sampling and periodic thereafter	Collect 100 mL of water in a headspace-free container to eliminate introduction of oxygen and analyze as soon as possible
Water	Sulfate (SO ₄ ²⁻)	IC method E300	Do not use the field method if this method is used.	Substrate for anaerobic microbial respiration	Initial MNA sampling and periodic thereafter	Collect at least 40 mL of water in a glass or plastic container; cool to 4°C
Water	Methane, ethane, and ethene	Kampbell <i>et al.</i> , 1989 or SW3810 Modified	Method published by researchers at the US Environmental Protection Agency. Limited to few commercial labs.	The presence of CH ₄ suggests BTEX degradation via methanogenesis. Ethane and ethene data are used where chlorinated solvents are suspected of undergoing biological transformation.	Initial MNA sampling and periodic thereafter	Collect water samples in 50 mL glass serum bottles with butyl gray/Teflon-lined caps; add H ₂ SO ₄ to pH less than 2, keep cool
Water	Alkalinity	Hach alkalinity test kit model AL AP MG-L	Phenolphthalein method	General water quality parameter used (1) to measure the buffering capacity of groundwater, and (2) as a marker to verify that all site samples are obtained from the same groundwater system;	Initial MNA sampling and periodic thereafter	Collect 100 mL of water in glass container
Water	Oxidation-reduction potential (ORP)	A2580B	Measurements made with electrodes; results are displayed on a meter; protect samples from exposure to oxygen. Report results against the hydrogen electrode (Eh) by adding a correction factor specific to the electrode used	The ORP of groundwater influences and is influenced by the nature of the biologically mediated degradation of contaminants; the ORP of groundwater may range from more than 800 mV to less than -400 mV.	Initial MNA sampling and periodic thereafter	Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately

Table 5-2
Natural Attenuation Analytical Methods, Data Uses, and Sampling and Handling Procedures
Boeing Tract 1, Hazelwood, Missouri

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation
Water	pH	Field probe with direct reading meter calibrated in the field according to the supplier's specifications.	Field	Aerobic and anaerobic processes are pH - sensitive	Initial MNA sampling and periodic thereafter	Collect 100–250 mL of water in a glass or plastic container; analyze immediately
Water	Temperature	Field probe with direct reading meter.	Field only	Well development	Initial MNA sampling and periodic thereafter	Not Applicable
Water	Conductivity	E120.1/SW9050, direct reading meter		General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system	Initial MNA sampling and periodic thereafter	Collect 100–250 mL of water in a glass or plastic container
Water	Chloride	IC method E300	Method SW9050 may also be used	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system. Final product of chlorinated solvent reduction.	Initial MNA sampling and periodic thereafter	Collect 250 mL of water in a glass container
Water	Total Organic Carbon	SW9060	Laboratory	Used to classify plume and to determine if cometabolism is possible in the absence of anthropogenic carbon	Initial MNA sampling and periodic thereafter	Collect 100 mL of water in a glass container, cool

Notes:

Modified from USEPA, 1998

* Analyses other than those listed in this table may be required for regulatory compliance.

^{a/} Optional

¹ "Hach" refers to the Hach Company catalog, 1990.

² "A" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th edition, 1992.

Table 6-1
Chemicals with Risk within a Factor of Ten of Target Risk
Boeing Tract 1, Hazelwood, Missouri

COCs	Area 1	Sub-area 2A	Sub-area 2B	Sub-area 2C	Sub-area 3A	Sub-area 3B	Sub-area 3C	Sub-area 3D	Sub-area 3E	Sub-area 3F	Sub-area 3G	Sub-area 3H	Area 4	Area 5	Sub-area 6A	Sub-area 6B	Sub-area 6C	Sub-area 6D	Area 7	Sub-area 8A	Sub-area 8B	Sub-area 8C	Area 9
Organics																							
1,1-Dichloroethane																nw, cw							
1,1-Dichloroethene																nw							
1,2,3-Trimethylbenzene																cw							
1,2,4-Trimethylbenzene																cw							
1,4-Dichlorobenzene																cw							
Benzene				cw							CW					cw							
Benzo(a)anthracene																CW, cw							
Chloroform																cw							
Dichlorodifluoromethane																nw, cw							
Methylene chloride												cw											
Tetrachloroethene (PCE)			NW, CW																				
trans-1,2-Dichloroethene																cw							
Trichloroethene (TCE)																nw, cw							
Vinyl chloride			NW, CW													nw, cw							
Aroclor 1254																cw							
Metals																							
Mercury												cw											
Total Petroleum Hydrocarbons																							
TPH-GRO				NW	CW																		
TPH-DRO				NW	CW							NW	NW										
TPH-ORO				NW						NW		NW	NW										NW
TPH-GRO Aliphatics >nC5 to nC8				nw, cw												cw							
TPH-GRO Aliphatics >nC9 to nC18				nw, cw												cw							
TPH-GRO Aromatics >nC9 to nC18				cw												cw							
TPH-DRO Aliphatics >nC9 to nC18				cw												nw, cw							
TPH-DRO Aromatics >nC9 to nC18				cw							cw					cw							
TPH-DRO Aliphatics > nC16 to nC21						NW										CW	CW						
TPH-ORO Aliphatics > nC21 to nC35						NW						CW											

Notes:

NW: Non-residential worker's risk greater than 10% of total target risk (1×10^{-6} for carcinogenic and 0.1 for non-carcinogenic) per RAM Group's Updated Risks

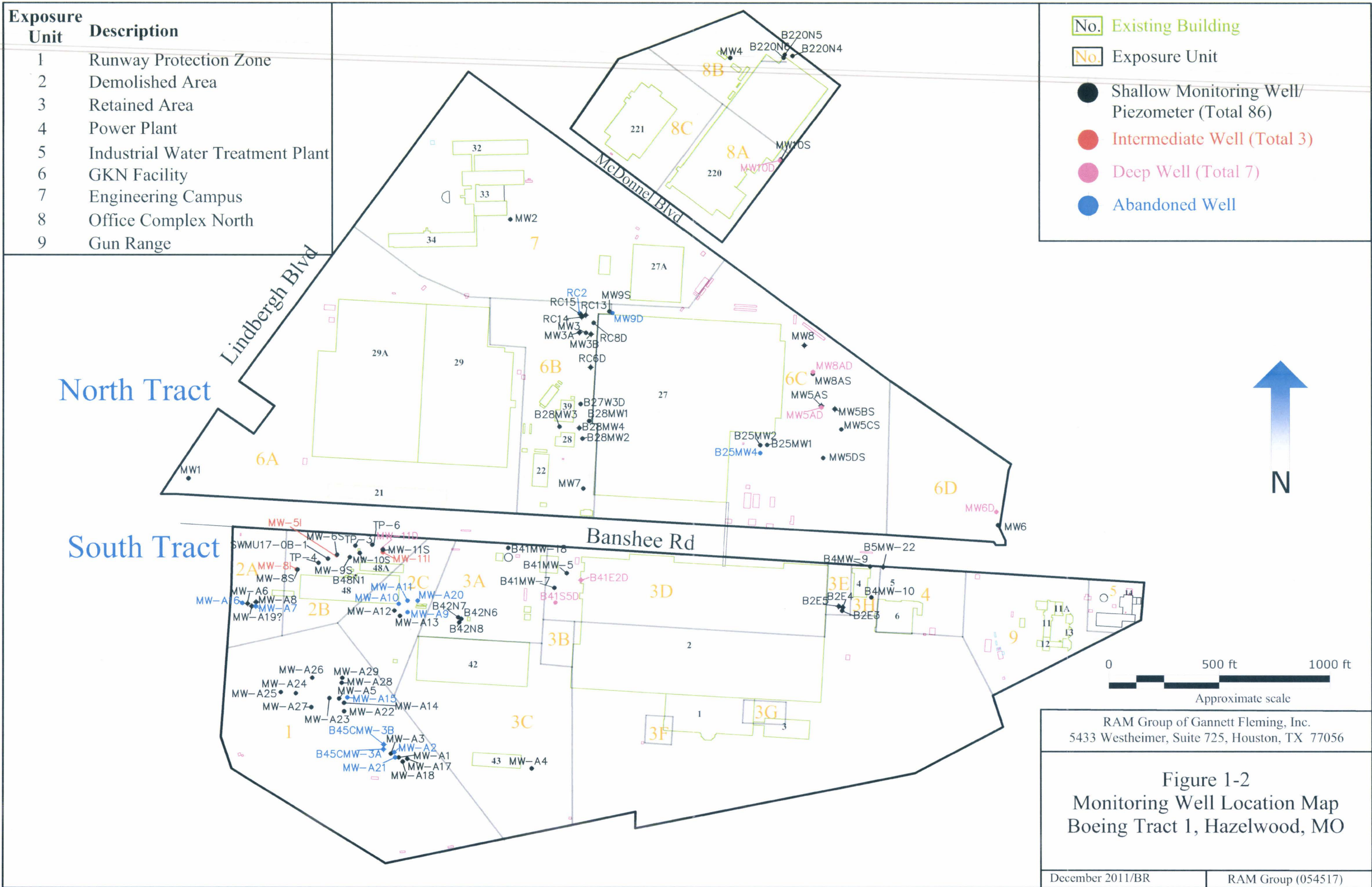
CW: Construction worker's risk greater than 10% of total target risk (1×10^{-6} for carcinogenic and 0.1 for non-carcinogenic) per RAM Group's Updated Risks

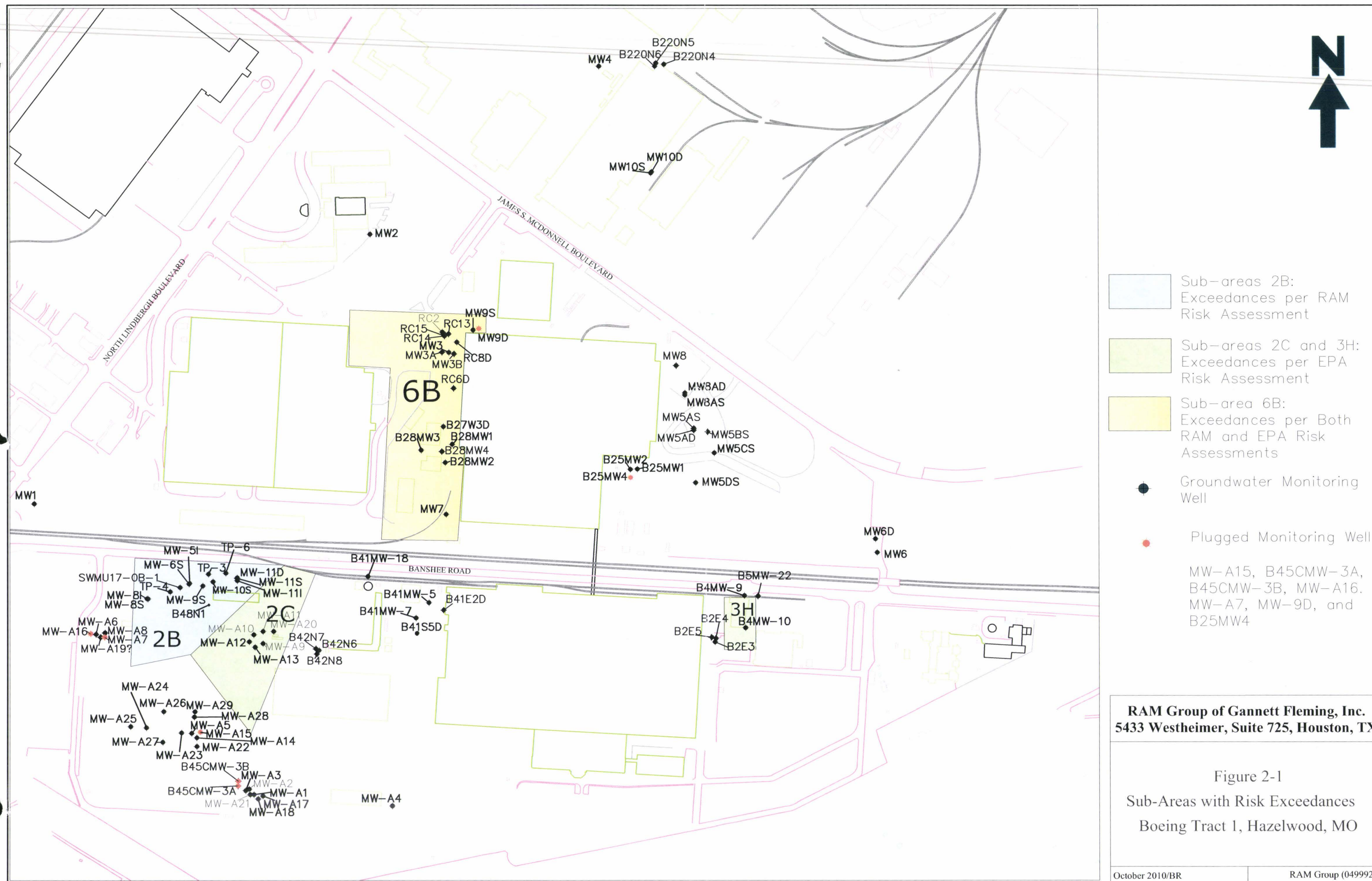
nw: Non-residential worker's risk greater than 10% of total target risk (1×10^{-6} for carcinogenic and 0.1 for non-carcinogenic) per Tetra Tech's RA

cw: Construction worker's risk greater than 10% of total target risk (1×10^{-6} for carcinogenic and 0.1 for non-carcinogenic) per Tetra Tech's RA

FIGURES

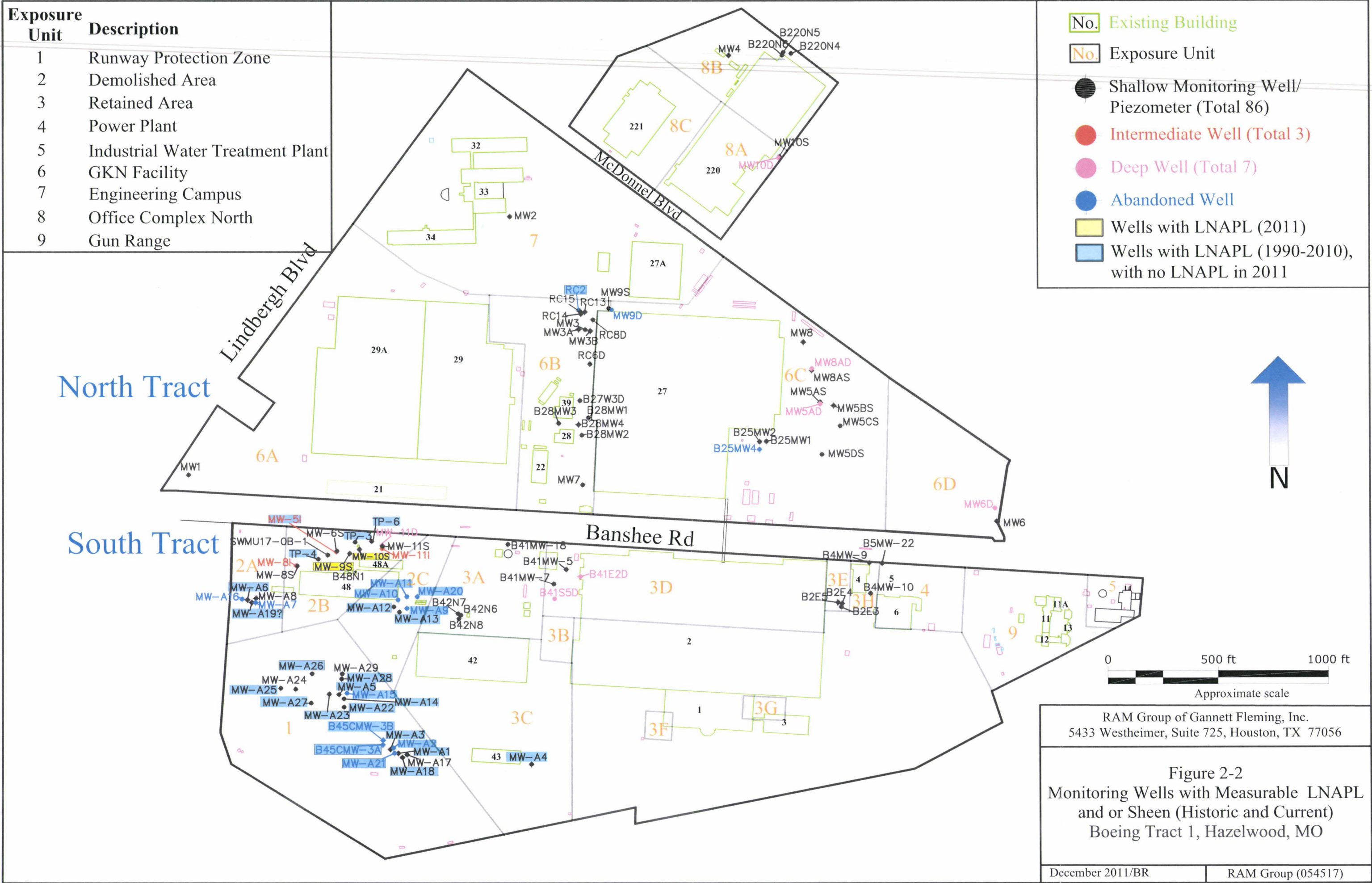






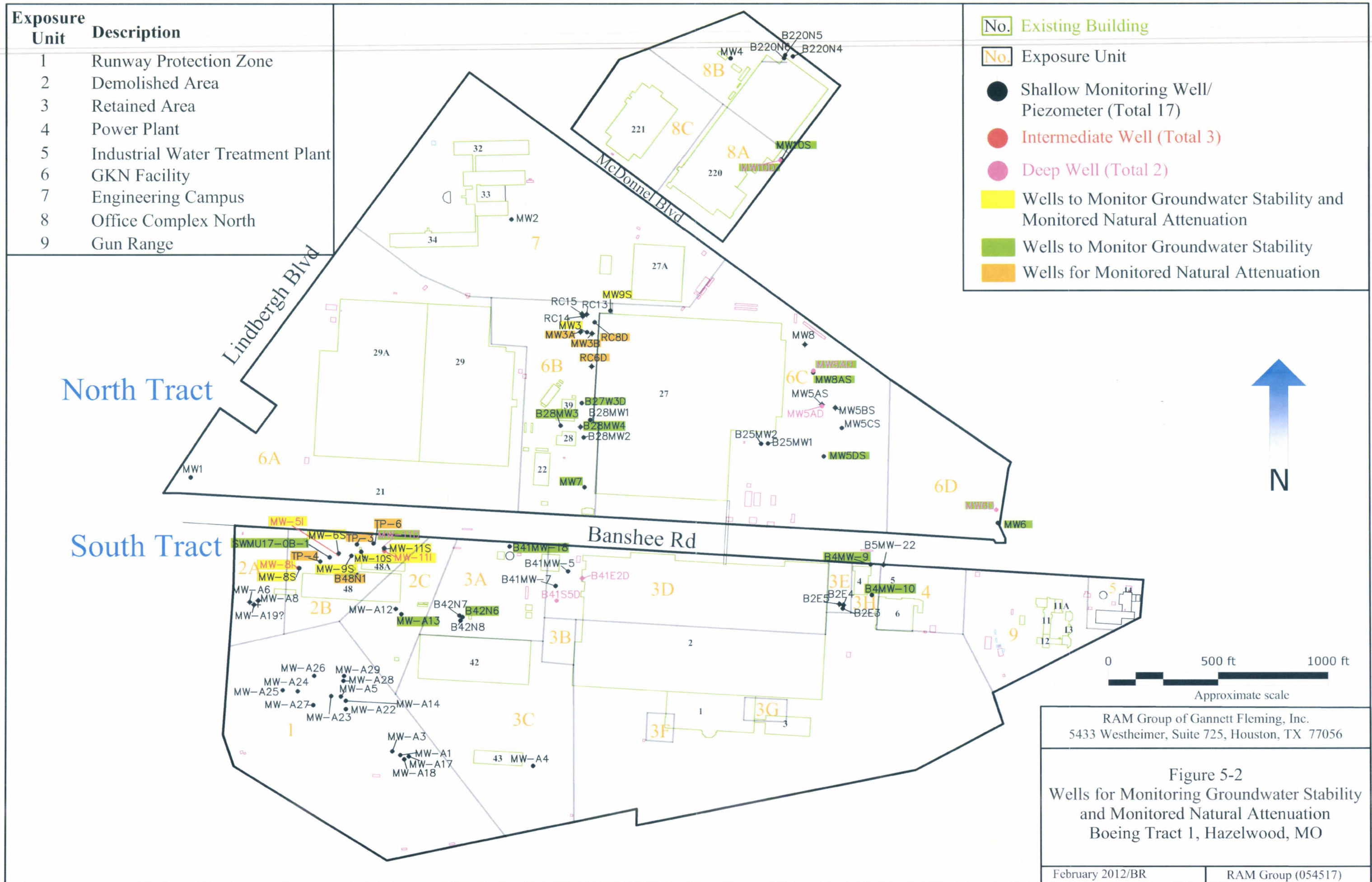
RAM Group of Gannett Fleming, Inc.
5433 Westheimer, Suite 725, Houston, TX

Figure 2-1
Sub-Areas with Risk Exceedances
Boeing Tract 1, Hazelwood, MO



Period	Stratigraphy	Thickness	Description	Boeing Groundwater Zones	SLAPS Groundwater Zones
Quaternary	Fill/topsoil (SLAPS Unit 1)	0-10'	Clay, silt, bricks, wood	Shallow groundwater	HZ-A
	Loess (SLAPS Unit 2)		Clayey silt		
	Glacio-lacustrine sequence (SLAPS Unit 3)	~75'	Organic silt Predominantly silt and silty clay		
			Predominantly clay and silty clay <i>May include residuum in lower strata.</i>	Deep groundwater	HZ-B
Pennsylvanian	Basal sands & gravels (SLAPS Unit 4)	0-5'	Sand/gravel within a clay matrix with sporadic clean sand/gravel intervals		HZ-C
	Cherokee Group (SLAPS Unit 5)	0-75'	Shale, siltstone, coal,	Shale bedrock	HZ-D
	Marmaton Group (SLAPS Unit 5)	0-80'	Shale, siltstone, limestone, sandstone & coal		
Mississippian	Ste. Genevieve Limestone (SLAPS Unit 6)	0-30'	Sandy Limestone	Limestone bedrock	HZ-E

Figure 5-1
Generalized Hydrogeological Column and Comparison to SLAPS (HZ), Boeing Tract 1 RFI, Hazelwood, Missouri



APPENDIX A
MDNR APPROVAL LETTERS FOR RFI, RISK ASSESSMENT, AND CMS WORK
PLAN

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Bob Holden, Governor • Stephen M. Mahfood, Director

www.dnr.mo.gov



RECEIVED

1/5/05

December 22, 2004

CERTIFIED MAIL – 7002 0860 0007 6968 1367
RETURN RECEIPT REQUESTED

Mr. Joseph Haake
Group Manager
The Boeing Company
Dept. 464C, Bldg. 220
Mail Code S221-1400
P.O. Box 516
St. Louis, MO 63166-0516

RE: Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report
Boeing Facility, Hazelwood, Missouri, Permit # MOD00818963

Dear Mr. Haake:

The Missouri Department of Natural Resources' Hazardous Waste Program (HWP) has completed review of the revised, consolidated final RFI Report dated December 2004. The RFI Report adequately addresses the comments and concerns previously raised by the HWP and is hereby approved. Please submit the minor RFI Report additions that were discussed during the December 8, 2004, meeting between the HWP, Boeing, and the city of St. Louis Airport Authority.

Boeing is reminded that this RFI approval presumes that two issues discussed in the HWP's November 23, 2004, comment letter will be addressed in the Risk Assessment and/or Corrective Measures Study (RA/CMS). One issue relates to the areas where the extent of contamination was not completely defined to the investigative threshold levels specified in the RFI Work Plan. To reiterate previous discussions between the HWP and Boeing, it needs to be understood that following development of site-specific clean-up levels, additional contaminant delineation may be necessary in some areas as part of the CMS. The second issue relates to Coldwater Creek. The HWP understands that the issues associated with Coldwater Creek will be addressed in the RA.

Integrity and excellence in all we do



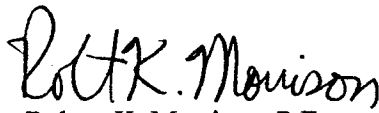
Mr. Joseph Haake
December 22, 2004
Page 2

As you know, the next major step in the corrective action process will be Boeing's preparation of a CMS to evaluate viable remedial alternatives and propose a preferred final remedy. The HWP expects to provide comments to Boeing in the near future regarding the draft CMS Work Plan outline that was presented by Boeing during the above-referenced meeting. In the meantime, the HWP is continuing its review of the previously-submitted RA. The HWP also awaits Boeing's submission of an interim measure work plan(s) in relation to potential focused removal actions, soil gas sampling, pilot study activities, and/or interim management of excavated soils generated during construction and utility-related activities.

If you have any questions or require any additional information, please do not hesitate to contact Ms. Jill Bruss of my staff at the Missouri Department of Natural Resources, HWP, P.O. Box 176, Jefferson City, MO 65102-0176, or by phone at (573) 751-3553.

Sincerely,

HAZARDOUS WASTE PROGRAM



Robert K. Morrison, P.E.
Chief, Permits Section

RKM:jbm

c: Ms. Joletta Golik, Airport Authority
Mr. Jeremy Johnson, United States Environmental Protection Agency Region VII
St. Louis Regional Office



RECEIVED
8-27-09



Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

August 24, 2009

CERTIFIED MAIL – 7004 1160 0000 8177 3797
RETURN RECEIPT REQUESTED

Mr. Joseph W. Haake
Group Manager
Environmental and Hazardous
Materials Services
The Boeing Company
Department 107E, Building 111
Mail Code S111-2491
P.O. Box 516
St. Louis, MO 63166-0516

RE: Risk-Based Corrective Action Report, Boeing Tract 1 Dated September 2004
Addendums to Risk-Based Corrective Action Report Dated June 29, 2009, and
Dated July 29, 2009, The Boeing Company, Hazelwood, Missouri
EPA ID# MOD000818963

Dear Mr. Haake:

This letter is to notify you that the Missouri Department of Natural Resources and the U.S. Environmental Protection Agency Region VII (EPA) reviewed The Boeing Company's Risk-Based Corrective Action Report, Boeing Tract 1, dated September 2004 and associated addendums dated June 29, 2009 and July 29, 2009. The Boeing Company submitted these documents as required by McDonnell Douglas' (a wholly owned subsidiary of The Boeing Company) Missouri Hazardous Waste Management Facility Part I Permit, Schedule of Compliance, Condition II, dated March 5, 1997. We are approving these documents based on our review.

Based on the results of the Resource Conservation and Recovery Act Facility Investigation Report approved on December 22, 2004, the Risk-Based Corrective Action Report, Boeing Tract 1, dated September 2004 and associated addendums dated June 29 and July 29, 2009, and the EPA's Final Risk Assessment, Boeing Tract 1 Facility, dated March 2008, the agencies' request

Mr. Joseph W. Haake
August 24, 2009
Page 2

Boeing progress to the next phase of the Corrective Action process and prepare a Corrective Measures Study (CMS) Work Plan in accordance with Section VII., CMS Work Plan of the Missouri Hazardous Waste Management Facility Part I Permit.

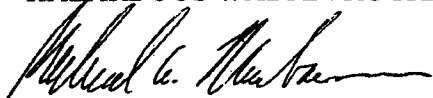
The CMS Work Plan shall be consistent with guidance contained in the EPA document entitled: RCRA Corrective Action Plan (Final), May 1994, OSWER Directive 9902.3-2A. The CMS Work Plan shall outline the general approach to investigating and evaluating potential remedies at the facility, including a description of all remedies that will be studied and a detailed description of any proposed pilot, laboratory, and/or bench scale studies.

Please submit the CMS Work Plan within 60 days of your receipt of this approval letter. Please submit three copies addressed to the Permits Section Chief, Hazardous Waste Program and two copies to Ms. Stephanie Doolan, at U.S. EPA Region VII at 901 North Fifth Street, Kansas City, KS 66101.

If you have any questions regarding this letter, please contact Christine Kump-Mitchell, P.E., of my staff, at the Missouri Department of Natural Resources, 7545 South Lindbergh, Suite 210, St. Louis, MO 63125-4839, or by phone at (314) 416-2960 or 1-800-361-4827, or by e-mail at christine.kump@dnr.mo.gov. Thank you.

Sincerely,

HAZARDOUS WASTE PROGRAM



Richard A. Nussbaum, P.E., R.G.
Chief, Permits Section

RAN:ckm

c: Ms. Stephanie Doolan, Project Manager, U.S. EPA Region VII
Ms. Joletta Golik, Environmental Manager, Lambert St. Louis International Airport
Ms. Christine Jump, Missouri State Coordinator, U.S. EPA Region VII
St. Louis Regional Office

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director

www.dnr.mo.gov

July 7, 2010

CERTIFIED MAIL -7009 0080 0000 1925 5442
RETURN RECEIPT REQUESTED

Mr. Joseph W. Haake
Group Manager
Environment Health and Safety
The Boeing Company
Department 107E, Building 111
Mail Code S111-2491
P.O. Box 516
St. Louis, MO 63166-0516

RE: Approval of Final Corrective Measures Study Work Plan Tract 1 Dated April 2010
The Boeing Company, Hazelwood, Missouri, EPA ID# MOD000818963

Dear Mr. Haake:

This letter is to notify you that the Missouri Department of Natural Resources' Hazardous Waste Program and the U.S. Environmental Protection Agency Region VII have completed review of the subject work plan.. This work plan was submitted by Boeing in accordance with the Hazelwood facility's Missouri Hazardous Waste Management Facility Part I Permit dated March 5, 1997. The Hazardous Waste Program and the Environmental Protection Agency hereby approve the subject work plan with the following comments and conditions.

Throughout the work plan, there are references to stabilizing the groundwater plume. While plume stabilization may be an interim goal, the ultimate goal of remediation should be to decrease the size of the plume and the contaminant concentrations within the plume.

Page 1-4, Section 1.2.3.2: This section concerns Sub-area 2B and dermal contact risks. Please note that in Table 2-1 there are other constituents of concern that present a dermal contact risk in Sub-area 6B.

The work plan includes a draft Missouri Environmental Covenant in Appendix D. While we had not expected to receive a fully developed draft of this environmental covenant until submission of the Corrective Measures Study (CMS) Report, we did note that the "Compliance Reporting" element has been lined out and recommended for elimination from the environmental covenant.



Recycled Paper

Mr. Joseph W. Haake
July 7, 2010
Page 2

A notation is included as follows: "Propose to delete this requirement as unnecessary given the use limitations." We believe this item is a necessary part of this environmental covenant to the extent that it will be proposed as part of the preferred final remedy in the CMS Report. While our post-remedy selection regulatory oversight does include periodic review and inspection of remedy elements, we do not have the resources to routinely confirm that the proper documents remain in the property chain of title. We cannot visit the recorder's office and/or perform on-line verification of property recordings at the frequency that we would like. We have, on occasion, checked for such documents at other sites and discovered them to be absent after they were filed with the recorder. It has therefore been our practice to require annual verification by the owner/operator that environmental covenants remain in place. Ultimately, we would like any environmental covenant to include this provision. The draft environmental covenant should be included in your CMS Report as part of the preferred final remedy.

If you have any questions regarding this letter, please contact Christine Kump-Mitchell, P.E., of my staff, at the Missouri Department of Natural Resources, 7545 South Lindbergh, Suite 210, St. Louis, MO 63125-4839, or by phone at (314) 416-2960 or 1-800-361-4827, or by e-mail at christine.kump@dnr.mo.gov. Thank you.

Sincerely,

HAZARDOUS WASTE PROGRAM



Richard A. Nussbaum, P.E., R.G.
Chief, Permits Section

RAN:bss

c: Ms. Joletta Golik, Environmental Manager, Lambert St. Louis International Airport
Ms. Christine Jump, Missouri State Coordinator, U.S. EPA Region VII
Ms. Amber Whisnant, Project Manager, U.S. EPA Region VII
St. Louis Regional Office, Missouri Department of Natural Resources

APPENDIX B
DESCRIPTION OF AREAS/SUB-AREAS

DESCRIPTION OF AREAS/SUB-AREAS BOEING TRACT 1, HAZELWOOD, MISSOURI

AREA 1: RUNWAY PROTECTION ZONE

The Runway Protection Zone is an Area approximately 1,500 feet long by 600 feet wide. Within this Area, there were 23 buildings or structures, in addition to portions of two buildings, and a small parking lot. All buildings within this Area have been demolished. As per FAA regulations, no buildings can be built in a runway protection zone. This Area is currently paved and will remain paved.

AREA 2: DEMOLISHED AREA

The Demolished Area is approximately 900 feet long by 750 feet wide. Within this Area were six buildings (four of which have been demolished). Portions of two buildings are left. The Area is currently paved. Under future construction plans, the remaining buildings are due to be demolished; however, it is not known whether new buildings will be constructed in the Area. It is anticipated that whatever the future building arrangements, the remainder of the Area will continue to be paved. For the purposes of this risk evaluation, Area 2 was further subdivided into three Sub-areas; 2A, 2B, and 2C, to (i) reduce the size of the exposure units evaluated, and (ii) to evaluate the risk from specific sources. A brief description of the Sub-areas follows:

- Sub-area 2A: This is the smallest of the three Sub-areas consisting of the western portion of Area 2 and covers an area of 3.03 acres. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.
- Sub-area 2B: This is the largest of the three Sub-areas consisting of the middle portion of Area 2 including SWMU 17 and covers an area of 4.48 acres. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.
- Sub-area 2C: This is the intermediate sized Sub-area consisting of the eastern/southeastern portion of Area 2 and covers an area of 3.88 acres. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs and TPH.

AREA 3: RETAINED AREA

The Retained Area is approximately 2,500 feet long by 1,200 feet wide. Within this Area are nine buildings, and a large parking lot. The Area is currently paved. Under future construction plans, the majority of the current buildings are due to be retained and the Area will continue to be paved. For the purposes of this risk evaluation, Area 3 was further subdivided into eight Sub-areas; 3A to 3H. A brief description of the Sub-areas follows:

- Sub-area 3A: This Sub-area is trapezoidal and located in the northwestern portion of Area 3 and covers about 5.25 acres. It extends from Banshee Road on the north to the northern edge of Building 42 on the south, and from Area 2C on the west to the middle of

Building 41 on the east. This Sub-area contained the Building 41 tankfarm and the northern portion of the pipeline that extended from the Building 41 tank farm to the Fuel Pits #1, 2, 3, and 4. Tanks have been removed and fuel pits were filled with clean fill and covered with concrete. Also, included in this Sub-area are building/structures #44, #44A, #46, and #49, and along the northern perimeter are railroad spurs and an industrial sewer line. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.

- Sub-area 3B: This Sub-area is rectangular and located on the west side of the southern portion of Building #2 and covers about 0.68 acres. This Sub-area is bounded on the north by Sub-area 3D, on the west and south by Sub-area 3C, and on the east by Building #2. This Sub-area contains the previous Aviation Gas Refueling Station and past UST #B68. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs and TPH. Industrial sewer has been blocked.
- Sub-area 3C: This Sub-area is a 7-sided polygon in the southwestern portion of Area 3 and covers about 11.91 acres. This Sub-area is bounded on the north by Sub-areas 2A and 2B, on the west by Sub-area 2C and Area 1, on the south by the Airport runway, and on the east by other portions of Area 3. This Sub-area contains Buildings #3, #42, #43, and #45H, the previous Fuel Pits #1 and #2, the previous Building #43 tankfarm and past USTs #B33 – B37, and associated pipelines connecting Fuel Pits #1 and #2 to the previous Building #41 and #43 tank farms, and connecting the two tankfarms together. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.
- Sub-area 3D: This Sub-area is rectangular and consists of the north-central portion of Area 3 and covers about 10 acres. This Sub-area is bounded on the north by Banshee Road, on the west by Sub-area 3A, on the south by Sub-area 3B and the southern half of Building #2, and on the east by Sub-area #3E. This Sub-area contains the northern half of Building #2, the eastern half of Building #41, and SWMU #22, and along the northern perimeter are railroad spurs and an industrial sewer line. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, PAHs, and metals.
- Sub-area 3E: This Sub-area is rectangular and located along the eastern portion of the northern half of Building #2 and covers about 0.62 acres. This Sub-area is bounded on the north by Banshee Road, on the west by Sub-area 3D, on the south by other portions of Area 3, and on the west by Sub-area 3H. This Sub-area contains SWMU #24, past UST #B24, and along the northern perimeter, railroad spurs. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.
- Sub-area 3F: This Sub-area is rectangular and located at the southwest corner of Building #1 and covers about 0.35 acres. This Sub-area is bounded on all sides by other portions of Area 3, and contains the southwest corner of Building #1 and past USTs #B20 and B21. The primary chemicals that exceeded screening criteria in this Sub-area were TPHs and metals.

- Sub-area 3G: This Sub-area is rectangular and located at the northeastern portion of Building #1 and covers about 0.45 acres. This Sub-area is bounded on the north by Building #2, on the west by the interior portion of Building #1, on the south by interior portions of Buildings #1 and #3, and on the east by other portions of Area 3. This Sub-area contains past USTs #B22 and #B23. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, and metals.
- Sub-area 3H: This Sub-area is rectangular and located in the northeastern portion of Area 3 and covers about 0.72 acres. This Sub-area is bounded on the north by Banshee Road, on the west by Sub-area 3E, on the south by other portions of Area 3, and on the east by Area 4. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, metals, PAHs.

AREA 4: POWER PLANT

The Power Plant is an area approximately 400 feet long by 300 feet wide. Within this Area, there were two main buildings (Building 5 has been demolished). Portions of flat lot are paved and others have gravel.

AREA 5: INDUSTRIAL WATER TREATMENT PLANT

The IWTP is an area approximately 240 feet long by 250 feet wide at its longest dimensions. Within this Area, there is one building, aeration tanks, sludge settling and equalization tanks, a sludge holding tank, filter press, and a parking lot.

AREA 6: GKN FACILITY

The GKN facility is approximately 4,000 feet long by 1,500 feet wide. Within this Area are three main buildings, five smaller buildings, and a large parking lot. The Area is currently paved. For the purposes of this risk evaluation, Area 6 will be further subdivided into four 6A, 6B, 6C, and 6D:

- Sub-area 6A: Buildings 21, 29, and 29A, and all parking lots and open space to the south and west of these buildings;
- Sub-area 6B: Between Buildings 29 and 27, containing Buildings 22, 28, 39;
- Sub-area 6C: Buildings 25 and 27 and all parking lots and open space to the south and within about 450 feet to the east; and
- Sub-area 6D: Parking lots and open areas beginning about 450 feet east of Buildings 25 and 27 and extending to the north, south, and east property lines.

Due to the large size of Area 6 and the presence of buildings that are likely to remain in the foreseeable future, Area 6 was subdivided to ensure that the representative concentrations calculated are as representative of the actual conditions as possible.

This Area formerly owned by Boeing has been sold to GKN Aerospace, who intends to continue manufacturing activities. Currently this Area is used for metal fabrication. As per Boeing's sale agreement with GKN, the Area has to be cleaned to allow the continuation of non-residential/industrial activities without unacceptable risk.

AREA 7: ENGINEERING CAMPUS

The Engineering Campus is approximately 1,500 feet long by 1,000 feet wide (at its maximum dimensions). Within this Area are four buildings and large parking lots. Other than the buildings, the entire area is paved.

AREA 8: OFFICE COMPLEX NORTH

The Office Complex North is an area approximately 800 feet wide by 1,000 feet long. Within this Area are two buildings (220 and 221) separated by a small parking lot. The Area is currently paved, and will likely remain paved in the future. For the purposes of this risk evaluation, Area 8 was further subdivided into three Sub-areas; 8A, 8B, and 8C, to (i) reduce the size of the exposure units evaluated, and (ii) to evaluate the risk from specific sources. A brief description of the Sub-areas follows:

- Sub-area 8A: This Sub-area covers about 4.4 acres and consists of the southern portion of Building 220 and associated parking and access areas along the south and east perimeter of the building. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs and metals.
- Sub-area 8B: This Sub-area covers about 6 acres and consists of the northern portion of Building 220 and open areas to the west and north of the building including parking, access, and operational areas and vegetated areas along the western and northern perimeter of the property. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs, TPH, PAHs, and metals.
- Sub-area 8C: This Sub-area covers about 5.8 acres and consists of Building 221 and the associated parking and access areas to the west, north, and east of the building. The primary chemicals that exceeded screening criteria in this Sub-area were VOCs and TPH.

AREA 9: GUN RANGE

The Gun Range is an area approximately 600 feet long by 500 feet wide. Within this Area, there are five main buildings and a parking lot.

APPENDIX C

MEMORANDUM ON AREAS TO BE EXCLUDED FROM THE PERMIT

*Transmitted by E-Mail
FIRST DRAFT*

To: Joe Haake
From: Atul Salhotra Ph.D.
Date: November 23, 2011
Re: **Areas to be Excluded from the Permit**

This memorandum presents our recommendations regarding the removal of certain areas from the Boeing permit. Our recommendations are based on one or a combination of the following factors:

1. Absence of ongoing manufacturing activities involving storage, disposal or treatment of waste,
2. Absence of SWMUs,
3. Absence of any current USTs,
4. Absence of contamination based on the environmental activities conducted at the site including RCRA Facility Investigation (RFI), Risk Assessment (RA), interim measures, and monitoring activities,
5. Acceptable risk for current and reasonable future receptors, and
6. No need for any further corrective actions.

The following sections discuss each area and Table 1 summarizes the exclusion rationale for each area and Figure 1 shows the areas.

Area 7 - Engineering Campus

The Engineering Campus (Area 7) is located in the northern portion of the Facility, bordered by Lindbergh Boulevard to the west and James S. McDonnell Boulevard to the north. The site is owned by Boeing.

No SWMUs were located within this area. There were six underground fuel storage tanks that were removed via excavation in 1989. During tank removal, no soil sampling activities were conducted due to the absence of any visual impacts. Subsequent to the removal of these tanks, as part of utility repairs and utility work, PID measurements were taken at these areas. Concentrations have always been below 5 ppm. One soil boring that was converted to a groundwater well (MW2) is located in this area. Soil and groundwater samples have been analyzed for a comprehensive list of 67 and over 100 analytes, respectively. The few chemicals detected were not site related. Additional details of this area are included as Attachment 1.

This area is being petitioned for removal from the permit due to the absence of manufacturing activities, SWMUs, and absence of any contamination related to the site activities.

Area 8 – Office Complex North

The Office Complex North (Area 8) is located to the north of James S. McDonnell Boulevard and covers an area approximately 800 feet wide by 1,000 feet long. Within this Area are two buildings (220 and 221) separated by a small parking lot.

No SWMUs were located in this area. An aboveground TCE degreaser with concrete containment was located in Building 220. This was removed in 1998. A trash compactor with a hydraulic oil system was located outside Building 220. Finally, a fuel oil UST was located near Building 221 that was removed in 1990 by excavation and confirmatory soil samples collected. In 2005, as a part of the interim corrective measures, 14 m³ of soil was excavated and removed offsite. For soil and groundwater data, results of the risk assessment, and additional details, refer Attachment 2.

This area is petitioned for removal from the permit due to absence of SWMUs, absence of site related COCs after interim remedial activities, and no need for any further remedial activities.

Area 1 – Runway Protection Zone

The Runway Protection Zone (Area 1) is located in the southern portion of the Facility, adjacent to the current runway and covers an area approximately 1,500 feet long by 600 feet wide. Within this Area, there were 23 buildings or structures, in addition to portions of two buildings, and a small parking lot. All buildings within this Area were demolished and the Area had been designated as a Runway Protection Zone. As per FAA regulations, no buildings can be built in a runway protection zone. This Area is currently paved. Additional details of this area are included as Attachment 3.

This area is petitioned for removal from the permit due to absence of any manufacturing activities, absence of current USTs, absence of any significant human activities in this area and no need for any further remedial activities.

Table 1
Exclusion Rationale for Areas to be Excluded From the Permit
Boeing, St. Louis, MO

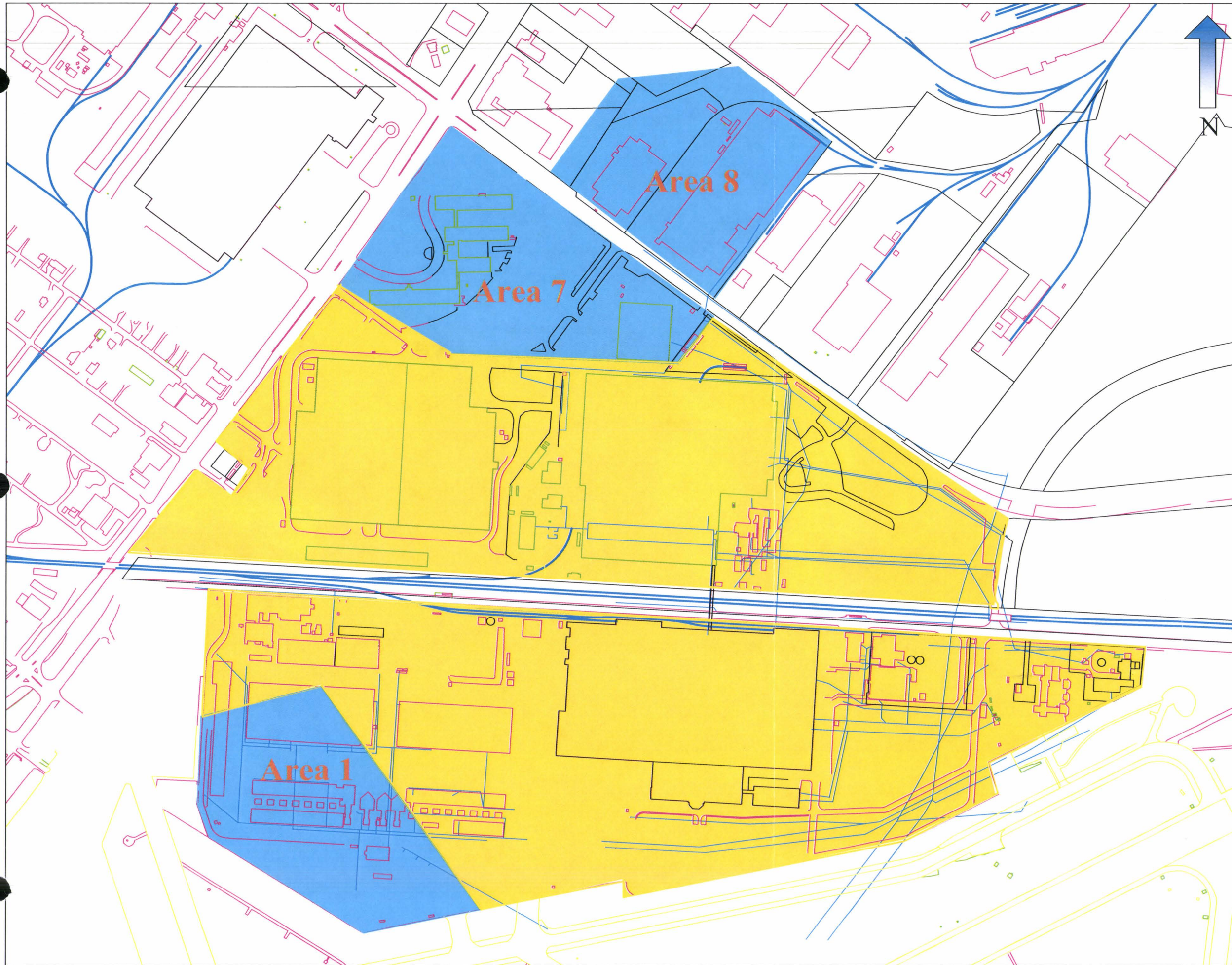
Area	Rationale (Factor)*					
	1	2	3	4	5	6
7 (Engineering Campus)	X	X	X	X	NA	NA
8 (Office Complex North)		X	X	X		X
1 (Runway Protection Zone)	X		X	X		X

Notes:

*: Factors for exclusion:

1. Absence of ongoing manufacturing activities involving storage, disposal or treatment of waste,
2. Absence of SWMUs;
3. Absence of any current USTs;
4. Absence of contamination based on the environmental activities conducted at the site including RCRA Facility Investigation (RFI), Risk Assessment (RA), interim measures, and monitoring activities
5. Acceptable risk for current and reasonable future receptors, and
6. No need for any further corrective actions

NA: Not applicable



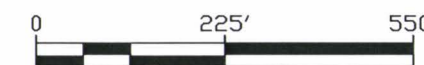
LEGEND



Areas to be Included in the Permit



Areas to be Excluded from the Permit



RAM Group of Gannett Fleming, Inc.
5433 Westheimer, Suite 725, Houston, TX 77056

Figure 1
Study Areas
Boeing Tract 1
St. Louis, Missouri

PROJ. NO: 054517

D/B:R/M

DATE: 11/11

Attachment 1
AREA 7: ENGINEERING CAMPUS

1.0 DESCRIPTION OF AREA

The Engineering Campus (Area 7) is located in the northern portion of the Facility, bordered by Lindbergh Boulevard to the west and James S. McDonnell Boulevard to the north. This area is approximately 1,500 feet long by 1,000 feet wide (at its maximum dimensions). Within this Area are four buildings and large parking lots. Other than the buildings, the entire area is paved.

2.0 POTENTIAL SOURCES WITHIN AREA

No SWMU's were located in this Area. Six USTs were previously located in this Area near the three main buildings (32, 33, and 34). The USTs ranged in size from 300 gallons to 20,000 gallons, and contained gasoline, fuel oil, and diesel.

The USTs were removed via excavation in 1989 and followed McDonnell Douglas environmental department guidelines that included an inspection of the excavation with further action initiated if contamination was visually observed. No further action was required at any of the six locations and no soil samples were analyzed.

At various times since the removal of the tanks, projects involving utility repair or replacement have been conducted at the former tank locations. Field testing of the soil was conducted during these projects to assist with proper soil disposal. As shown in the following table, no PID readings above 5 ppm were detected at the former UST sites.

Tank No.	Tank Location	Material	Gallons	Installation Date	PID Test Date	PID Location	PID Results
B46	33A	Diesel	300/3,000	1956/1960	6/26/00	At UST site	5 ppm
B47	33B	Fuel Oil	20,000	1956	11/13/01	20 feet west of UST	3 ppm
B48	32A	Gasoline	300/500	1956/1975	5/16/03	10 feet north of UST	<1 ppm
B49	32B	Fuel Oil	10,000	1955	4/27/00	At UST site	5 ppm
B50	34A	Diesel	850	1957	4/21/03	At UST site	< 1 ppm
B51	34B	Fuel Oil	10,000	1957	4/21/03	At UST site	< 1 ppm

3.0 AVAILABLE DATA

The following gives an overview of the available data within this Area:

- One monitoring well (MW2) is located within this Area, and this well has been sampled eight times from July 2000 to June 2003;
- At the time of installation of MW2 in July 2000, a soil sample was collected. This is the only laboratory analyzed soil data within this Area; and
- Soil PID data is available as presented above.

4.0 CONSTITUENTS IDENTIFIED IN SOIL

One soil sample was collected from the boring used to install monitoring well MW2, in July 2000. This sample was analyzed for a comprehensive list of 67 constituents that included VOCs, PAHs, PCBs, TPH, metals, and cyanide.

None of the detected constituents including six metals and one organic were considered site related i.e. were either background or an artifact of sampling.

No constituents were therefore considered for quantitative risk evaluation for soil.

5.0 CONSTITUENTS IDENTIFIED IN GROUNDWATER

One groundwater monitoring well (MW2) is located within Area 7, and has been sampled eight times between July 2000 and June 2003 (Table A1-1). In all, these samples were analyzed for 110 constituents consisting of VOCs, PAHs, PCBs, TPH, metals, and cyanide.

Of the constituents analyzed, nine were detected in at least one sample: arsenic, barium, benzene, chromium, cis-1,2-dichloroethene, lead, mercury, selenium, and toluene. These constituents were not considered further in the risk assessment because the concentrations were below the MCLs.

Chemicals with concentrations below the reporting limits were also carefully evaluated (RAM Group, 2004) and not considered site related.

Based on the above evaluation and the lack of industrial activities in this Area, no constituents were considered for quantitative risk evaluation for groundwater.

6.0 RISK ASSESSMENT

Quantitative risk assessment was not conducted because no chemicals of concern (COC) were identified the soil and groundwater.

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,2-Trichloroethane	1,1-Dichloro-2-propanone	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropene	1,2,3-Trimethylbenzene	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene
Screening Value		0.52	200	0.067	59000	5	NA	2.4	7	NA	29	0.00072	NA	70	15	0.00032	0.05	600
MW2	7/27/2000		<1	<1		<1		<1	<1									
	1/9/2001	<5	<5	<5		<5		<5	<5	<5	<5	<5		<5	<5	<5	<5	<5
	5/8/2001	<1	<1	<1		<1		<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
	7/18/2001	<1	<1	<1		<1		<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
	10/29/2001	<1	<1	<1		<1		<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
	3/11/2002	<1	<1	<1		<1		<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
	5/31/2002	<1	<1	<1		<1		<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
	6/20/2003	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,2-Dichloroethane	1,2-Dichloroethene, Total	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,4-Dichlorobenzene	2,2-Dichloropropane	2-Chloroethyl vinyl ether	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	Acetone	Acrolein	Acrylonitrile	Benzene	Bromobenzene
Screening Value		5	330	5	370	89.3	730	75	NA	NA	730	47	2600	22000	0.042	0.045	5	88
MW2	7/27/2000	<1	0.66J	<1								<5		<10			<1	
	1/9/2001	<5	<5	<5	<5	<5	<5	<5	<5		<5	<10	<5	<10			<5	<5
	5/8/2001	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	<1	<1
	7/18/2001	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	<1	<1
	10/29/2001	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	<1	<1
	3/11/2002	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	<1	<1
	5/31/2002	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	<1	<1
	6/20/2003	<1		<1	<1	<1	<1	<1	<1	<50	<1		<1	<50	<50	<50	3.5	<1

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Bromochloro- thane	Bromodichloro- methane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2- Dichloroethene	cis-1,3- Dichloropropene	Dibromochloro- methane	Dibromomethane	Dichlorodifluoro- methane	Diisopropyl ether	Ethylbenzene
Screening Value		54.4	80	80	8.7	1000	5	100	48.5	80	190	70	0.43	80	8.2	390	830	700
MW2	7/27/2000		<1	<1	<2	<1	<1	<1	<2	0.34J	<2		<1	<1				<1
	1/9/2001	<5	<5	<5	<10	<5	<5	<5	<10	<5	<10	<5	<5	<5	<5	<10		<5
	5/8/2001		<1	<1	<1		<1	<1	<1	<5	<1	1.4	<1	<1	<1	<1	<1	<1
	7/18/2001		<1	<1	<1		<1	<1	<1	<5	<1	2	<1	<1	<1	<1	<1	<2
	10/29/2001		<1	<1	<1		<1	<1	<1	<5	<1	1.5	<1	<1	<1	<1	<1	<1
	3/11/2002		<1	<1	<1		<1	<1	<1	<5	<1	1.5	<1	<1	<1	<1	<1	<1
	5/31/2002		<1	<1	<1		<1	<1	<1	<5	<1	1.1H	<1	<1	<1	<1	<1	<1
	6/20/2003		<1	<1	<1		<1	<1	<1	<5	<1	1.4	<1	<1	<1	<1	<1	<1

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Hexachlorobutadiene	Iodomethane	Isopropylbenzene	m,p-Xylenes	Methyl tert-butyl ether	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	p-Isopropyltoluene	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene
Screening Value		0.86	8.59	680	1200	12	5	0.14	98.9	1300	1200	786	106	100	103	5	1000	100
MW2	7/27/2000						<1	<5						<1		<1	<1	
	1/9/2001	<5	<10	<5	<5	<10	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5	<5
	5/8/2001			<1		<1	<5	<1	<1	<1		<1	<1	<1	<1	<1	1	<1
	7/18/2001	<1		<1		<1	<5	<2	<1	<1		<1	<1	<1	<1	<1	<5	<1
	10/29/2001	<1		<1		<1	<5	<3	<1	<1		<1	<1	<1	<1	<1	<5	<1
	3/11/2002	<1		<1		<1	<5	<5	<1	<1		<1	<1	<1	<1	<1	<5	<1
	5/31/2002	<1		<1		<1	<5	<5	<1	<1		<1	<1	<1	<1	<1	<5	<1
	6/20/2003	<1		<1		<1	<5	<5	<1	<1		<1	<1	<1	<1	<1	<5	<1

Notes:

NA: Not available

1/2RL > SV

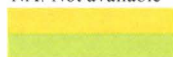
Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	trans-1,3- Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	Xylenes, Total	Arsenic	Barium	Cadmium	Chromium	Mercury	Arsenic, Dissolved	Barium, Dissolved	Cadmium, Dissolved	Chromium, Dissolved	Mercury, Dissolved	Aroclor 1016
Screening Value		NA	5	1300	410	2	10000	10	2000	5	100	2	10	2000	5	100	2	0.96
MW2	7/27/2000	<1	<1			<2	<1	16.8	664	<5	140	0.083B						<1.1
	1/9/2001	<5	<5	<10	<10	<10	<5	<50	320	<10	29	<0.2						
	5/8/2001	<1	<1	<1		<1	<3	15	380	<2	29	<0.2	9.9	220	<2	4.4	<0.2	
	7/18/2001	<1	<1	<1		<1	<3	<5	300	<2	<2	<0.2	5	270	<2	<2	<0.2	
	10/29/2001	<1	<1	<1		<1	<3	5.7	4420J	<2	49J	<0.2	<5	270	<2	<2	<0.2	
	3/11/2002	<1	<1	<1		<1	<3											
	5/31/2002	<1	<1	<1		<1	<3											
	6/20/2003	<1	<1	<1		<1	<3											

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene
Screening Value		0.0068	0.0068	0.034	0.034	0.034	0.034	0.029	0.0029	0.029	26.4	0.29	2.9	0.0029	0.056	1500	0.029	75
MW2	7/27/2000	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	1/9/2001																	
	5/8/2001																	
	7/18/2001																	
	10/29/2001																	
	3/11/2002																	
	5/31/2002																	
	6/20/2003																	

Notes:

NA: Not available

1/2RL > SV

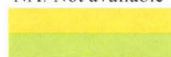
Detect > SV

Table A1-1
Comprehensive Groundwater Analytical Data for Area 7
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Pyrene	Lead	TPH as Diesel	Volatile Petroleum Hydrocarbons	Cyanide, total	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone	Selenium	Silver
Screening Value		1100	15	34300	NA	NA	NA	NA	NA	NA
MW2	7/27/2000	<5	27.5	<500	<100	<5	<5	<5	5	<10
	1/9/2001		<50				<10	<10	<100	<20
	5/8/2001		7				<50	<50		
	7/18/2001		<5				<50	<50		
	10/29/2001		<5				<50	<50		
	3/11/2002						<50	<50		
	5/31/2002						<50	<50		
	6/20/2003						<50	<50		

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Attachment 2
AREA 8: OFFICE COMPLEX NORTH

1.0 DESCRIPTION OF AREA AND POTENTIAL SOURCES

The Office Complex North (Area 8) is located to the north of James S. McDonnell Boulevard. This area is approximately 800 feet wide by 1,000 feet long. Within this Area are two buildings (220 and 221) separated by a small parking lot. The Area is currently paved, and will likely remain paved in the future. For risk evaluation, Area 8 was subdivided into three Sub-areas; 8A, 8B, and 8C. A brief description of the Sub-areas follows:

- Sub-area 8A: This Sub-area covers about 4.4 acres and consists of the southern portion of Building 220 and associated parking and access areas along the south and east perimeter of the building. The trichloroethene degreaser was situated within Building 220, aboveground in a concrete containment area, and was removed in 1998. Soil samples were collected and analyzed during the removal activities.
- Sub-area 8B: This Sub-area covers about 6 acres and consists of the northern portion of Building 220 and open areas to the west and north of the building including parking, access, operational and vegetated areas along the western and northern perimeter of the property. A trash compactor with a hydraulic oil system was located at the north end of Building 220. Hydraulic oil had leaked from the compactor onto the adjacent asphalt.
- Sub-area 8C: This Sub-area covers about 5.8 acres and consists of Building 221 and the associated parking and access areas to the west, north, and east of the building. A fuel oil UST was located near the southeast corner of Building 221. The fuel oil UST was removed in 1990 by excavation, and three confirmatory soil samples were collected.

No SWMUs were located within this Area.

2.0 AVAILABLE DATA

The following gives an overview of the available data within the Area:

- Three monitoring wells are located within this Area (MW10S and MW10D in Sub-area 8A, and MW4 in Sub-area 8B), and have been sampled up to 20 times since July 2000;
- A total of 17 soil borings (including the three monitoring well borings) have been advanced in this Area (ten in Sub-area 8A, four in Sub-area 8B, and three in Sub-area 8C);
- Groundwater samples were collected once from eight piezometers in 2000;
- Three confirmatory soil samples were collected during UST removal activities in 1990; and
- Three confirmatory soil samples were collected during soil excavation activities in 2005 as part of the interim remediation;

3.0 CONSTITUENTS IDENTIFIED IN SOIL

The soil samples were analyzed for a comprehensive list of constituents that included VOCs, PAHs, PCBs, TPH, metals, and cyanide. The following 16 constituents were detected in at least one soil sample:

METALS		ORGANICS/TPH	
Arsenic	Chromium	1,2-Dichloroethene (total)	Tetrachloroethene
Barium	Lead	Acetone	Trichloroethene
Cadmium	Mercury	cis-1,2- Dichloroethene	Benzo(b)fluoranthene
		Methylene chloride	Chrysene
		Methyl ethyl ketone (MEK)	TPH (2 types)

4.0 CONSTITUENTS IDENTIFIED IN GROUNDWATER

Groundwater samples were analyzed for a comprehensive list of constituents that included VOCs, PAHs, PCBs, TPH, metals, and cyanide. The following 15 constituents were detected in at least one groundwater sample in the RCRA Facility Investigation (RFI) (MACTEC, 2004):

METALS	ORGANICS/TPH	
Arsenic	1,1-Dichloroethane	Methylene chloride
Barium	1,1-Dichloroethene	Toluene
Chromium	1,2-Dichloroethene (total)	Trichloroethene
Lead	Bromomethane	Vinyl chloride
Mercury	cis-1,2-Dichloroethene	TPH (2 types)
Manganese		

Groundwater data is presented in Table A2-1.

5.0 INTERIM REMEDIAL MEASURES

Interim remedial measures consisting of soil removal have been conducted in this area in 2005. Specifically, an area of 10 ft X 10 ft X 5 ft was excavated and a total of 23 tons of soil removed from sub-area 8B.

6.0 RISK ASSESSMENT

In Sub-areas 8A and 8C, the calculated risks for all the COCs and all potentially complete routes of exposure for the non-residential worker and the construction worker are below the acceptable target risks.

In Sub-area 8B, initial risk assessment indicated that the cumulative non-carcinogenic risk for the non-residential worker exceeded the target risk due to the indoor inhalation of aliphatics C12 – C16, aliphatics C16, C21, and aliphatics C21 – C35 from groundwater. However, these

exceedances were found to be not a concern. Therefore, the risks for the non-residential worker and the construction worker are below the acceptable target risks in Sub-area 8B.

7.0 REFERENCES

MACTEC Engineering and Consulting, Inc., 2004. RCRA Facility Investigation Report for Boeing, Hazelwood, Missouri.

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,2-Trichloroethane	1,1-Dichloro-2-propanone	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropene	1,2,3-Trimethylbenzene	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene
Screening Value		0.52	200	0.067	59000	5	NA	2.4	7	NA	29	0.00072	NA	70	15	0.00032	0.05	600
Sub-area 8A																		
B22011	7/25/2000							<1	0.88J									
B22013	11/14/2000							<5	<5									
MW10D	9/26/2000							<5	<5									
	1/12/2001							<5	<5									
	5/9/2001							<1	<1									
	7/20/2001							<1	<1									
	10/25/2001							<1	<1									
	3/8/2002							<1	<1									
	5/29/2002							<1	<1									
	8/12/2002							<1	<1									
	12/6/2002							<1	<1									
	3/14/2003							<1	<1									
	6/25/2003							<1	<1									
	11/20/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/26/2010 - LF	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/26/2010 - SS	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	10/25/2010 - LF	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	10/25/2010 - SS	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	7/12/2011	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW10S	9/26/2000							16	<5									
	1/9/2001							13	<5									
	5/9/2001							17	<1									
	7/20/2001							17H	<1									
	10/25/2001							16H	<1									
	3/7/2002							14H	<1									
	5/29/2002							10	<1									
	8/12/2002							13	<1									
	12/3/2002							8.1	<1									
	3/14/2003							8.7	<1									
	6/25/2003							11	<1									
	7/20/2001 (Dup)							18	<1									
	10/25/2001 (Dup)							16H	<1									
	3/7/2002 (Dup)							14H	<1									
	11/20/2008	<5	<5	<5	<20	<5	<50	3.5 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/26/2010 - LF	<5	<5	<5	<20	<5	<50	2.2 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/26/2010 - SS	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	10/25/2010 - LF	<5	<5	<5	<20	<5	<50	2.4 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	10/25/2010 - SS	<5	<5	<5	<20	<5	<50	1.6 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	7/12/2011	<5	<5	<5	<20	<5	<50	1.6 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,2-Trichloroethane	1,1-Dichloro-2-propanone	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzenes	1,2,3-Trichloropropene	1,2,3-Trimethylbenzene	1,2,4-Trichlorobenzenes	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzenes
Screening Value		0.52	200	0.067	59000	5	NA	2.4	7	NA	29	0.00072	NA	70	15	0.00032	0.05	600
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																	
B220N6	11/21/2008																	
MW4	7/27/2000							<1	<1									
	1/9/2001							<5	<5									
	5/9/2001							<1	<1									
	7/20/2001							<1	<1									
	10/25/2001							<1	<1									
	3/8/2002							<1	<1									
	5/29/2002							<1	<1									
	6/25/2003							<1	<1									
	11/21/2008																	
	11/21/2008 (Dup)																	
	4/28/2010																	
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000							<1	<1									
B221E3	7/26/2000							<1	<1									

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,2-Dichloroethane	1,2-Dichloroethene, Total	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,3-Dichloropropene, Total	1,4-Dichloro-2-butene, Total	1,4-Dichlorobenzene	1-Chlorobutane	2,2-Dichloropropane	2-Butanone	2-Chloroethyl vinyl ether	2-Chlorotoluene	2-Hexanone	2-Nitropropane	4-Chlorotoluene
Screening Value		5	330	5	370	89.3	730	0.43	0.0012	75	1500	NA	7100	NA	730	47	0.0018	2600
Sub-area 8A																		
B22011	7/25/2000		54D															
B22013	11/14/2000																	
MW10D	9/26/2000																	
	1/12/2001		<5															
	5/9/2001																	
	7/20/2001																	
	10/25/2001																	
	3/8/2002																	
	5/29/2002																	
	8/12/2002																	
	12/6/2002																	
	3/14/2003																	
	6/25/2003																	
	11/20/2008	< 5		< 5	< 5	< 5	< 5			< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/26/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/26/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	10/25/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	10/25/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	7/12/2011	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW10S	9/26/2000																	
	1/9/2001		<5															
	5/9/2001																	
	7/20/2001																	
	10/25/2001																	
	3/7/2002																	
	5/29/2002																	
	8/12/2002																	
	12/3/2002																	
	3/14/2003																	
	6/25/2003																	
	7/20/2001 (Dup)																	
	10/25/2001 (Dup)																	
	3/7/2002 (Dup)																	
	11/20/2008	< 5		< 5	< 5	< 5	< 5			< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/26/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/26/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	10/25/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	10/25/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	7/12/2011	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,2-Dichloroethane	1,2-Dichloroethene, Total	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,3-Dichloropropene, Total	1,4-Dichloro-2-butene, Total	1,4-Dichlorobenzene	1-Chlorobutane	2,2-Dichloropropane	2-Butanone	2-Chloroethyl vinyl ether	2-Chlorotoluene	2-Hexanone	2-Nitropropane	4-Chlorotoluene
Screening Value		5	330	5	370	89.3	730	0.43	0.0012	75	1500	NA	7100	NA	730	47	0.0018	2600
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																	
B220N6	11/21/2008																	
MW4	7/27/2000		<1															
	1/9/2001		<5															
	5/9/2001																	
	7/20/2001																	
	10/25/2001																	
	3/8/2002																	
	5/29/2002																	
	6/25/2003																	
	11/21/2008																	
	11/21/2008 (Dup)																	
	4/28/2010																	
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000		<1															
B221E3	7/26/2000		<1															

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	4-Methyl-2-pentanone	Acetone	Acetonitrile	Acrolein	Acrylonitrile	Allyl chloride	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Butyl acetate	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane
Screening Value		2000	22000	130	0.042	0.045	0.65	5	88	54.4	80	80	8.7	NA	1000	5	100	48.5
Sub-area 8A																		
B22011	7/25/2000												<2					
B22013	11/14/2000												<10					
MW10D	9/26/2000												<10					
	1/12/2001												<10					
	5/9/2001												<1					
	7/20/2001												<1					
	10/25/2001												<1					
	3/8/2002												<1					
	5/29/2002												<1					
	8/12/2002												<1					
	12/6/2002												<1					
	3/14/2003												<1					
	6/25/2003												<1					
	11/20/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/26/2010 - LF	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/26/2010 - SS	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	10/25/2010 - LF	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	10/25/2010 - SS	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	7/12/2011	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW10S	9/26/2000												<10					
	1/9/2001												<10					
	5/9/2001												<1					
	7/20/2001												<1					
	10/25/2001												<1					
	3/7/2002												<1					
	5/29/2002												<1					
	8/12/2002												<1					
	12/3/2002												<1					
	3/14/2003												<1					
	6/25/2003												<1					
	7/20/2001 (Dup)												<1					
	10/25/2001 (Dup)												<1					
	3/7/2002 (Dup)												<1					
	11/20/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/26/2010 - LF	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/26/2010 - SS	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	10/25/2010 - LF	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	10/25/2010 - SS	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	7/12/2011	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	4-Methyl-2-pentanone	Acetone	Acetonitrile	Acrolein	Acrylonitrile	Allyl chloride	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Butyl acetate	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane
Screening Value		2000	22000	130	0.042	0.045	0.65	5	88	54.4	80	80	8.7	NA	1000	5	100	48.5
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																	
B220N6	11/21/2008																	
MW4	7/27/2000												<2					
	1/9/2001												<10					
	5/9/2001												<1					
	7/20/2001												<1					
	10/25/2001												<1					
	3/8/2002												<1					
	5/29/2002												51.8J					
	6/25/2003												<1					
	11/21/2008																	
	11/21/2008 (Dup)																	
	4/28/2010																	
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000												<2					
B221E3	7/26/2000												<2					

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Chloroform	Chloromethane	Chloroprene	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	cis-1,4-Dichloro-2-butene	Cyclohexanone	Dibromochloromethane	Dibromomethane	Dichlorodifluoromethane	Ethyl acetate	Ethyl ether	Ethyl methacrylate	Ethylbenzene	Heptane	Hexachlorobutadiene	Hexachloroethane
Screening Value		80	190	14	70	0.43	0.0012	180000	80	8.2	390	33000	7300	3300	700	NA	0.86	4.8
Sub-area 8A																		
B22011	7/25/2000														<1			
B22013	11/14/2000				<2.5										<5			
MW10D	9/26/2000				<2.5										<5			
	1/12/2001				<5										<5			
	5/9/2001				<1										<1			
	7/20/2001				<1										<1			
	10/25/2001				<1										<1			
	3/8/2002				<1										<1			
	5/29/2002				<1										1.1H			
	8/12/2002				<1										<1			
	12/6/2002				<1										<1			
	3/14/2003				<1										<1			
	6/25/2003				<1										<1			
	11/20/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	4/26/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	4/26/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	10/25/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	10/25/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	7/12/2011	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
MW10S	9/26/2000				3.1										<5			
	1/9/2001				<5										<5			
	5/9/2001				3.3										<1			
	7/20/2001				4H										<1			
	10/25/2001				3.5H										<1			
	3/7/2002				2.9H										<1			
	5/29/2002				2.2										<1			
	8/12/2002				2.8										<1			
	12/3/2002				1.7										<1			
	3/14/2003				2.5										<1			
	6/25/2003				2.4										<1			
	7/20/2001 (Dup)				4.1										<1			
	10/25/2001 (Dup)				3.6H										<1			
	3/7/2002 (Dup)				3.2H										<1			
	11/20/2008	< 5	< 10	< 20	1.3 J	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	4/26/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	4/26/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	10/25/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	10/25/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10
	7/12/2011	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 10	< 5	< 5	< 5	< 20	< 5	< 10

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Chloroform	Chloromethane	Chloroprene	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	cis-1,4-Dichloro-2-butene	Cyclohexanone	Dibromochloromethane	Dibromomethane	Dichlorodifluoromethane	Ethyl acetate	Ethyl ether	Ethyl methacrylate	Ethylbenzene	Heptane	Hexachlorobutadiene	Hexachloroethane
Screening Value		80	190	14	70	0.43	0.0012	180000	80	8.2	390	33000	7300	3300	700	NA	0.86	4.8
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																	
B220N6	11/21/2008																	
MW4	7/27/2000														<1			
	1/9/2001				<5										<5			
	5/9/2001				<1										<1			
	7/20/2001				<1										<1			
	10/25/2001				<1										<1			
	3/8/2002				<1										<1			
	5/29/2002				<1										<1			
	6/25/2003				<1										<1			
	11/21/2008																	
	11/21/2008 (Dup)																	
	4/28/2010																	
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000														<1			
B221E3	7/26/2000														<1			

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Iodomethane	Isopropylbenzene	m,p-Xylenes	Methacrylonitrile	Methyl acetate	Methyl Methacrylate	Methyl tert-butyl ether	Methylacrylate	Methylene chloride	Naphthalene	n-Butylbenzene	n-Hexane	Nitrobenzene	n-Propylbenzene	o-Xylene	Pentachloroethane	p-Isopropyltoluene
Screening Value		8.59	680	1200	1	37000	1400	12	1100	5	0.14	98.9	880	0.12	1300	1200	0.75	786
Sub-area 8A																		
B22011	7/25/2000									<1								
B22013	11/14/2000									<5								
MW10D	9/26/2000									<5								
	1/12/2001									<5								
	5/9/2001									<5								
	7/20/2001									<5								
	10/25/2001									<5								
	3/8/2002									<5								
	5/29/2002									<5								
	8/12/2002									<5								
	12/6/2002									<5								
	3/14/2003									<5								
	6/25/2003									<5								
	11/20/2008	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5	< 20	< 5
	4/26/2010 - LF	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	4/26/2010 - SS	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	10/25/2010 - LF	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	10/25/2010 - SS	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	7/12/2011	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
MW10S	9/26/2000									<5								
	1/9/2001									<5								
	5/9/2001									<5								
	7/20/2001									<5								
	10/25/2001									<5								
	3/7/2002									<5								
	5/29/2002									<5								
	8/12/2002									<5								
	12/3/2002									<5								
	3/14/2003									<5								
	6/25/2003									<5								
	7/20/2001 (Dup)									<5								
	10/25/2001 (Dup)									<5								
	3/7/2002 (Dup)									<5								
	11/20/2008	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5	< 20	< 5
	4/26/2010 - LF	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	4/26/2010 - SS	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	10/25/2010 - LF	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	10/25/2010 - SS	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5
	7/12/2011	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5		< 20	< 5

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Iodomethane	Isopropylbenzene	m,p-Xylenes	Methacrylonitrile	Methyl acetate	Methyl Methacrylate	Methyl tert-butyl ether	Methylacrylate	Methylene chloride	Naphthalene	n-Butylbenzene	n-Hexane	Nitrobenzene	n-Propylbenzene	o-Xylene	Pentachloroethane	p-Isopropyltoluene
Screening Value		8.59	680	1200	1	37000	1400	12	1100	5	0.14	98.9	880	0.12	1300	1200	0.75	786
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																	
B220N6	11/21/2008																	
MW4	7/27/2000									<1								
	1/9/2001									<5								
	5/9/2001									<5								
	7/20/2001									<5								
	10/25/2001									<5								
	3/8/2002									<5								
	5/29/2002									<5								
	6/25/2003									<5								
	11/21/2008																	
	11/21/2008 (Dup)																	
	4/28/2010																	
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000									0.57JB								
B221E3	7/26/2000									0.46JB								

Notes:

NA: Not available



1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Propionitrile	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	trans-1,4-Dichloro-2-butene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	Xylenes, Total	TPH - GRO (C6 - C10)	TPH-DRO (C10 - C21)
Screening Value		NA	106	100	103	5	20.3	1000	100	NA	0.0012	5	1300	410	2	10000	18100	34300
Sub-area 8A																		
B22011	7/25/2000							<1				220D			<2	<1		
B22013	11/14/2000							<5				<5			<5	<5		
MW10D	9/26/2000							<5				<5			<5	<5		
	1/12/2001							<5				<5			<10	<5		
	5/9/2001							1.3				<1			<1	<3		
	7/20/2001							<5				<1			<1	<3		
	10/25/2001							<5				<1			<1	<3		
	3/8/2002							<5				1.2			<1	<3		
	5/29/2002							46H				<1			<1	6.4H		
	8/12/2002							<5				<1			<1	<3		
	12/6/2002							<5				<1			<1	<3		
	3/14/2003							<5				<1			<1	<3		
	6/25/2003							<5				<1			<1	<3		
	11/20/2008	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	15.4	< 5	< 10	< 2			
	4/26/2010 - LF	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	4.1 J	< 5	< 10	< 2	< 5		
	4/26/2010 - SS	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	8.2	< 5	< 10	< 2	< 5		
	10/25/2010 - LF	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	2.4 J	< 5	< 10	< 2	< 5		
	10/25/2010 - SS	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	5.3	< 5	< 10	< 2	< 5		
	7/12/2011	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	< 2	< 5		
MW10S	9/26/2000							<5				<5			<5	<5		
	1/9/2001							<5				<5			<10	<5		
	5/9/2001							1.4				<1			3.1	<3		
	7/20/2001							<5				<1			3.6H	<3		
	10/25/2001							<5				<1			2.8H	<3		
	3/7/2002							<5				<1			2.4H	<3		
	5/29/2002							<5				<1			2.7	<3		
	8/12/2002							<5				<1			2.4	<3		
	12/3/2002							<5				<1			2.4	<3		
	3/14/2003							<5				<1			2.6	<3		
	6/25/2003							<5				<1			1.4	<3		
	7/20/2001 (Dup)							<5				<1			3.3	<3		
	10/25/2001 (Dup)							<5				<1			2.9H	<3		
	3/7/2002 (Dup)							<5				<1			2.4H	<3		
	11/20/2008	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	57.4	< 5	< 10	0.9 J			
	4/26/2010 - LF	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	1.3 J	< 5		
	4/26/2010 - SS	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	1.4 J	< 5		
	10/25/2010 - LF	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	1.5 J	< 5		
	10/25/2010 - SS	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	1.4 J	< 5		
	7/12/2011	< 50	< 5	< 5	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10	< 2	< 5		

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Propionitrile	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	trans-1,4-Dichloro-2-butene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	Xylenes, Total	TPH - GRO (C6 - C10)	TPH-DRO (C10 - C21)
Screening Value		NA	106	100	103	5	20.3	1000	100	NA	0.0012	5	1300	410	2	10000	18100	34300
Sub-area 8B																		
B220N1	7/25/2000																	
	4/29/2004																	
B220N2	9/20/2000																	
B220N3	9/20/2000																	
B220N4	11/21/2008																<500	220J
B220N6	11/21/2008																<500	400J
MW4	7/27/2000							<1				<1			<2	<1		
	1/9/2001							<5				<5			<10	<5		
	5/9/2001							<1				<1			<1	<3		
	7/20/2001							<5				<1			<1	<3		
	10/25/2001							<5				<1			<1	<3		
	3/8/2002							<5				<1			<1	<3		
	5/29/2002							<5				<1			<1	<3		
	6/25/2003							<5				<1			<1	<3		
	11/21/2008																<500	<300
	11/21/2008 (Dup)																<500	200J
	4/28/2010																<500	<300
Sub-area 8C																		
B221E1	7/25/2000																	
B221E2	7/26/2000							<1				<1			<2	<1		
B221E3	7/26/2000							<1				<1			<2	<1		

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	TPH-ORO (C21 - C35)	Arsenic	Barium	Cadmium	Chromium	Manganese	Mercury	Arsenic, Dissolved	Barium, Dissolved	Chromium, Dissolved	Manganese, Dissolved	Lead	TPH as Diesel	Volatile Petroleum Hydrocarbons	nC6 to nC12 (GRO-TX1005)	nC12 to nC28 (DRO-TX1005)	nC28 to nC35 (ORO-TX1005)
Screening Value		31800	10	2000	5	100	880	2	10	2000	100	880	15	34300	NA	NA	NA	NA
Sub-area 8A																		
B22011	7/25/2000																	
B22013	11/14/2000																	
MW10D	9/26/2000		<10	418		105		<0.2					10.7					
	1/12/2001		<50	367		59		<0.2		266			<50					
	5/9/2001		<5	310		<2		<0.2					<5					
	7/20/2001		<5	410		3.4		<0.2					7.4					
	10/25/2001		<5	440		16		<0.2					16					
	3/8/2002																	
	5/29/2002																	
	8/12/2002																	
	12/6/2002																	
	3/14/2003																	
	6/25/2003																	
	11/20/2008		0.17 J	398		12.8	939											
	4/26/2010 - LF		< 25	315		6.8 J	948		< 25	274	< 10	301						
	4/26/2010 - SS		< 25	323		10.1	500											
	10/25/2010 - LF		42.2				1880											
	10/25/2010 - SS		< 25				1650											
	7/12/2011																	
MW10S	9/26/2000		23.5	1010		123		<0.2					47.6					
	1/9/2001		<250	3600		610		<2					<250					
	5/9/2001		<5	490		13		<0.2		290			5.7					
	7/20/2001		<5	250		3.4		<0.2					6.4					
	10/25/2001		<5	190		6.7		<0.2		140			7					
	3/7/2002																	
	5/29/2002																	
	8/12/2002																	
	12/3/2002																	
	3/14/2003																	
	6/25/2003																	
	7/20/2001 (Dup)		<5	280		3.8		<0.2					5.8					
	10/25/2001 (Dup)		<5	200		6.7		<0.2		140			8.8					
	3/7/2002 (Dup)																	
	11/20/2008		11 J	257		< 10	1630											
	4/26/2010 - LF		< 25	216		5.2 J	2080		< 25	205	4.6 J	2000						
	4/26/2010 - SS		31.7	244		< 10	1920											
	10/25/2010 - LF		< 25				1810											
	10/25/2010 - SS		< 25				1960											
	7/12/2011																	

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	TPH-ORO (C21 - C35)	Arsenic	Barium	Cadmium	Chromium	Manganese	Mercury	Arsenic, Dissolved	Barium, Dissolved	Chromium, Dissolved	Manganese, Dissolved	Lead	TPH as Diesel	Volatile Petroleum Hydrocarbons	nC6 to nC12 (GRO-TX1005)	>nC12 to nC28 (DRO-TX1005)	>nC28 to nC35 (ORO-TX1005)
Screening Value		31800	10	2000	5	100	880	2	10	2000	100	880	15	34300	NA	NA	NA	NA
Sub-area 8B																		
B220N1	7/25/2000													35000				
	4/29/2004															<500	64000	32000
B220N2	9/20/2000		13.2	332		44.3		<0.2					19.2	<500	<100			
B220N3	9/20/2000		17.7	518		59.4		<0.2					18.8	<500	<100			
B220N4	11/21/2008	<284	14J			4.2J												
B220N6	11/21/2008	<600	15J			<10												
MW4	7/27/2000		34.9	783		153		0.11B					49.3	<500	<100			
	1/9/2001		<50	440		72		<0.2					<50					
	5/9/2001		<5	320		15		<0.2		160			6.3					
	7/20/2001		<5	220		5.2		<0.2		190			7.1					
	10/25/2001		<5	370		7.9		<0.2		280			6.1					
	3/8/2002																	
	5/29/2002																	
	6/25/2003																	
	11/21/2008	<300	16J			<10												
	11/21/2008 (Dup)	<300	16J			<10												
	4/28/2010	<300	<25			<10			<25		<10							
Sub-area 8C																		
B221E1	7/25/2000													<500	650			
B221E2	7/26/2000													<830	<100			
B221E3	7/26/2000													<500	<100			

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Total Petroleum Hydrocarbon (TX1005)	Aliphatics nC6 (TX1006)	Aliphatics >nC6 to nC8 (TX1006)	Aliphatics >nC8 to nC10 (TX1006)	Aliphatics >nC10 to nC12 (TX1006)	Aliphatics >nC12 to nC16 (TX1006)	Aliphatics >nC16 to nC21 (TX1006)	Aliphatics >nC21 to nC35 (TX1006)	Aromatics >nC7 to nC8 (TX1006)	Aromatics >nC8 to nC10 (TX1006)	Aromatics >nC10 to nC12 (TX1006)	Aromatics >nC12 to nC16 (TX1006)	Aromatics >nC16 to nC21 (TX1006)	Aromatics >nC21 to nC35 (TX1006)	Total Petroleum Hydrocarbons (TX1006)
Screening Value		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sub-area 8A																
B22011	7/25/2000															
B22013	11/14/2000															
MW10D	9/26/2000															
	1/12/2001															
	5/9/2001															
	7/20/2001															
	10/25/2001															
	3/8/2002															
	5/29/2002															
	8/12/2002															
	12/6/2002															
	3/14/2003															
	6/25/2003															
	11/20/2008															
	4/26/2010 - LF															
	4/26/2010 - SS															
	10/25/2010 - LF															
	10/25/2010 - SS															
MW10S	7/12/2011															
	9/26/2000															
	1/9/2001															
	5/9/2001															
	7/20/2001															
	10/25/2001															
	3/7/2002															
	5/29/2002															
	8/12/2002															
	12/3/2002															
	3/14/2003															
	6/25/2003															
	7/20/2001 (Dup)															
	10/25/2001 (Dup)															
	3/7/2002 (Dup)															
	11/20/2008															
	4/26/2010 - LF															
	4/26/2010 - SS															
	10/25/2010 - LF															
	10/25/2010 - SS															
	7/12/2011															

Table A2-1
Comprehensive Groundwater Analytical Data for Area 8
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Total Petroleum Hydrocarbon (TX1005)	Aliphatics nC6 (TX1006)	Aliphatics >nC6 to nC8 (TX1006)	Aliphatics >nC8 to nC10 (TX1006)	Aliphatics >nC10 to nC12 (TX1006)	Aliphatics >nC12 to nC16 (TX1006)	Aliphatics >nC16 to nC21 (TX1006)	Aliphatics >nC21 to nC35 (TX1006)	Aromatics >nC7 to nC8 (TX1006)	Aromatics >nC8 to nC10 (TX1006)	Aromatics >nC10 to nC12 (TX1006)	Aromatics >nC12 to nC16 (TX1006)	Aromatics >nC16 to nC21 (TX1006)	Aromatics >nC21 to nC35 (TX1006)	Total Petroleum Hydrocarbons (TX1006)
Screening Value		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sub-area 8B																
B220N1	7/25/2000															
	4/29/2004	96000	<500	<500	<500	<500	5000	15000	50000	<500	<500	<500	2000	4000	20000	96000
B220N2	9/20/2000															
B220N3	9/20/2000															
B220N4	11/21/2008															
B220N6	11/21/2008															
MW4	7/27/2000															
	1/9/2001															
	5/9/2001															
	7/20/2001															
	10/25/2001															
	3/8/2002															
	5/29/2002															
	6/25/2003															
	11/21/2008															
	11/21/2008 (Dup)															
	4/28/2010															
Sub-area 8C																
B221E1	7/25/2000															
B221E2	7/26/2000															
B221E3	7/26/2000															

Notes:

NA: Not available

1/2RL > SV
Detect > SV

Attachment 3
AREA 1: RUNWAY PROTECTION ZONE

1.0 INTRODUCTION

The Runway Protection Zone (Area 1) is located in the southern portion of the Facility, adjacent to the current runway (see Figure 2-1) and covers an area approximately 1,500 feet long by 600 feet wide. All buildings within this Area were demolished and the Area has been designated as a Runway Protection Zone. As per FAA regulations, no buildings can be built in a runway protection zone. This Area is currently paved and will remain paved. This area is owned by the airport.

2.0 POTENTIAL SOURCES WITHIN AREA

The following five SWMUs were identified in this Area during the RFA investigation (SAIC, 1995):

- SWMU 12: Waste jet aircraft fuel and hydraulic system spillage (UST B28 2,130-gallon waste fuel/hydraulic oil UST);
- SWMU 13: 3,380-gallon waste jet fuel and hydraulic fluid USTs (B26 and B27);
- SWMU 14: Two 2,000-gallon waste jet fuel USTs (B29 and B30). Fuel pits #3 and #4;
- SWMU 23: Less than 90 day storage area with capacity for twenty-eight 55-gallon drums for waste solvents, paints, and oils; and
- SWMU 26: Former less than 90-day storage area with capacity for twenty-eight 55-gallon drums for waste solvents, paints, and oils.

A total of five USTs were present in the area and all have been excavated.

Additionally, a petroleum pipeline (carrying jet fuels JP-5 and JP-8) traversed this Area to the south of Building 45 and was connected to a tank farm located to the north (outside of Area 1). The pipeline has been emptied and abandoned in place.

3.0 AVAILABLE DATA

The following provides an overview of the available data within the Area:

- Nineteen monitoring wells are located within this Area, of which two are inactive.
- Groundwater monitoring has been performed since 1990 to date.
- Seventeen soil borings completed as piezometers exist in this Area and have been sampled for groundwater once since 2000.
- A total of 21 soil borings and two pits have been sampled within this Area since 1992 resulting in 28 individual soil samples.

4.0 CONSTITUENTS IDENTIFIED IN SOIL

From 1992 to date, 28 soil samples have been collected during various investigations. The soil samples have been analyzed for a comprehensive list of constituents that included VOCs, SVOCs, PCBs, TPH, and metals. The data indicates that the following 26 constituents were detected in at least one soil sample:

METALS		VOCs/TPH
Aluminum	Lead	Acetone
Antimony	Magnesium	Benzene
Arsenic	Manganese	Ethylbenzene
Barium	Mercury	Toluene
Beryllium	Nickel	TPH (2 types)
Chromium	Potassium	Xylenes
Cobalt	Selenium	
Copper	Sodium	
Iron	Vanadium	
Calcium	Zinc	

Several of these metals represent background concentrations.

5.0 CONSTITUENTS IDENTIFIED IN GROUNDWATER

During the various investigations conducted within this Area, groundwater samples were analyzed for a comprehensive list of constituents that included VOCs, TPH, and metals. Of the various constituents analyzed in groundwater, the following 21 constituents were detected in at least one groundwater sample in RCRA Facility Investigation (MACTEC, 2004):

METALS	VOCs/TPH	
Arsenic	1,2,3-Trimethylbenzene	Acetone
Barium	1,2,4-Trimethylbenzene	Benzene
Chromium	Ethylbenzene	Xylenes
Lead	Isopropyl benzene	Toluene
	Naphthalene	TPH (3 types)
	n-Butylbenzene	MTBE
	n-Propylbenzene	sec-Butylbenzene
	p-Isopropyltoluene	tert-Butylbenzene
		Trichloroethene

Refer to Table A3-1 for the groundwater analytical data.

6.0 LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL)

LNAPL has been observed within this Area near Buildings 45C, 45D, and 45E (Hush Houses/SWMU 12, 13, 23) where USTs for jet fuel and hydraulic fluid and 55-gallon drums

were formerly located. LNAPL removal activities have been performed in this Area since 1989. Based on the removal activities, LNAPL is currently essentially nonexistent.

Table A3-2 shows the LNAPL for wells in this area. The table indicates that in recent years, LNAPL thicknesses have been stable at low levels. Further, since dissolved concentrations of benzene, toluene, ethylbenzene, and total xylenes (BTEX) show a clear decreasing trend, the residual LNAPL is not an ongoing source of constituents. This has also been confirmed by taking water samples below the LNAPL.

7.0 RISK ASSESSMENT

The calculated risk for all the COCs and all potentially complete routes of exposure for the construction worker is below the acceptable target levels.

8.0 REFERENCES

MACTEC Engineering and Consulting, Inc., 2004. RCRA Facility Investigation Report for Boeing, Hazelwood, Missouri.

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,2-Trichloroethane	1,1-Dichloro-2-propanone	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropene	1,2,3-Trimethylbenzene	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene
Screening Value		0.52	200	0.067	59000	5	NA	2.4	7	NA	29	0.00072	NA	70	15	0.00032	0.05	600
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003																	
	11/19/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	6.42	<5	<5	<5	1	<5
	11/4/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A3	6/26/2003	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	11/19/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	11/4/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A15	7/2/2003	<10	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10
	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A17	6/26/2003	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
MW-A18	6/26/2003	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	7/29/2003	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5		<5	<5	<5	<5	<5
MW-A22	11/1/2002																	
	3/20/2003																	
	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A23	5/3/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	7/2/2003																	
	7/29/2003	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5		<5	<5	<5	<5	<5
	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	5/3/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A25	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/30/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	11/4/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A26	11/18/2008	<5	<5	<5	<20	1 J	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/30/2010	<5	<5	<5	<20	<5	<50	1.2 J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A27	11/1/2002																	
	7/29/2003	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5		<5	<5	<5	<5	<5
	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	5/3/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A28	5/3/2010 (Dup)	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	5/3/2010 - SS	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	5/3/2010 - LF	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	11/3/2010 - SS	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
MW-A29	11/3/2010 - LF	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	11/18/2008	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
B40E1	5/3/2010	<5	<5	<5	<20	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	11/14/2002	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1		<1
B40E2	11/14/2002	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1		<1
B40S1	11/14/2002	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1		<1

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,2-Trichloroethane	1,1-Dichloro-2-propanone	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropene	1,2,3-Trimethylbenzene	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene
Screening Value		0.52	200	0.067	59000	5	NA	2.4	7	NA	29	0.00072	NA	70	15	0.00032	0.05	600
B40S2	11/14/2002	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1		<1
B40W1	11/14/2002	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1		<1
B45CMW-3A	7/2/2003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	3.4	<1	1.7	<1	<1	<1
B45CMW-3B	6/26/2003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
B45CS1D	11/15/2002																	
B45CS2	11/14/2002																	
B45CS3D	11/20/2002																	
B45S1D	11/18/2002																	
B45S2	11/18/2002																	
B45S3	11/18/2002																	
B45S4	11/18/2002																	
	11/18/2002 (Dup)																	
B45S5D	11/19/2002																	
B45S6	11/18/2002																	
B45S7	11/19/2002																	

Notes:

NA: Not available

1/2RL > SV
Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,2-Dichloroethane	1,2-Dichloroethene, Total	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,3-Dichloropropene, Total	1,4-Dichloro-2-butene, Total	1,4-Dichlorobenzene	1-Chlorobutane	2,2-Dichloropropane	2-Butanone	2-Chloroethyl vinyl ether	2-Chlorotoluene	2-Hexanone	2-Nitropropane	4-Chlorotoluene
Screening Value		5	330	5	370	89.3	730	0.43	0.0012	75	1500	NA	7100	NA	730	47	0.0018	2600
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003																	
	11/19/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	11/4/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A3	6/26/2003	< 1		< 1	< 1	< 1	< 1			< 1		< 1		< 50	< 1			< 1
	11/19/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	11/4/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A15	7/2/2003	< 10		< 10	< 10	< 10	< 10			< 10		< 10		< 500	< 10			< 10
	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A17	6/26/2003	< 1		< 1	< 1	< 1	< 1			< 1		< 1		< 50	< 1			< 1
MW-A18	6/26/2003	< 1		< 1	< 1	< 1	< 1			< 1		< 1		< 50	< 1			< 1
	7/29/2003	< 5		< 5	< 5	< 5	< 5			< 5		< 5		< 10	< 5	< 10	< 10	< 5
MW-A22	11/1/2002																	
	3/20/2003																	
	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A23	5/3/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	7/2/2003																	
	7/29/2003	< 5		< 5	< 5	< 5	< 5			< 5		< 5		< 10	< 5	< 10	< 10	< 5
	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	49	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	5/3/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A25	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/30/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	11/4/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A26	11/18/2008	< 5	1.4 J	< 5	< 5	< 5	< 5	< 5	< 10	< 5	1.8 J	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	4/30/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A27	11/1/2002																	
	7/29/2003	< 5		< 5	< 5	< 5	< 5			< 5		< 5		< 10	< 5	< 10	< 10	< 5
	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	5/3/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A28	5/3/2010 (Dup)	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	5/3/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	5/3/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	11/3/2010 - SS	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
MW-A29	11/3/2010 - LF	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	11/18/2008	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
	5/3/2010	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 5	< 5	< 5	< 25	< 20	< 5	< 25	< 50	< 5
B40E1	11/14/2002	< 1		< 1	< 1	< 1	< 1			< 1		< 1			< 1			< 1
B40E2	11/14/2002	< 1		< 1	< 1	< 1	< 1			< 1		< 1			< 1			< 1
B40S1	11/14/2002	< 1		< 1	< 1	< 1	< 1			< 1		< 1			< 1			< 1

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,2-Dichloroethane	1,2-Dichloroethene, Total	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,3-Dichloropropene, Total	1,4-Dichloro-2-butene, Total	1,4-Dichlorobenzene	1-Chlorobutane	2,2-Dichloropropane	2-Butanone	2-Chloroethyl vinyl ether	2-Chlorotoluene	2-Hexanone	2-Nitropropane	4-Chlorotoluene
Screening Value		5	330	5	370	89.3	730	0.43	0.0012	75	1500	NA	7100	NA	730	47	0.0018	2600
B40S2	11/14/2002	<1		<1	<1	<1	<1			<1		<1			<1			<1
B40W1	11/14/2002	<1		<1	<1	<1	<1			<1		<1			<1			<1
B45CMW-3A	7/2/2003	<1		<1	<1	<1	<1			<1		<1		<50	<1			<1
B45CMW-3B	6/26/2003	<1		<1	<1	<1	<1			<1		<1		<50	<1			<1
B45CS1D	11/15/2002																	
B45CS2	11/14/2002																	
B45CS3D	11/20/2002																	
B45S1D	11/18/2002																	
B45S2	11/18/2002																	
B45S3	11/18/2002																	
B45S4	11/18/2002																	
	11/18/2002 (Dup)																	
B45S5D	11/19/2002																	
B45S6	11/18/2002																	
B45S7	11/19/2002																	

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	4-Methyl-2-pentanone	Acetone	Acetonitrile	Acrolein	Acrylonitrile	Allyl chloride	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Butyl acetate	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane
Screening Value		2000	22000	130	0.042	0.045	0.65	5	88	54.4	80	80	8.7	NA	1000	5	100	48.5
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003							<0.5										
	11/19/2008	< 25	104	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	2 J	< 5	< 5	< 10
	11/4/2010	< 25	12 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A3	6/26/2003		<50		<50	<50		<1	<1		<1	<1	<1			<1	<1	<1
	11/19/2008	< 25	16 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	11/4/2010	< 25	23 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A15	7/2/2003		<500		<500	<500		34	<10		<10	<10	<10			<10	<10	<10
	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	1.1 J	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A17	6/26/2003		60		<50	<50		<1	<1		<1	<1	<1			<1	<1	<1
MW-A18	6/26/2003		<50		<50	<50		<1	<1		<1	<1	<1			<1	<1	<1
	7/29/2003		<20	<10	<10	<10	<5	<5	<5	<5	<5	<5	<5		<10	<5	<5	<5
MW-A22	11/1/2002							2										
	3/20/2003							1.4										
	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A23	7/2/2003							28										
	7/29/2003		<20	<10	<10	<10	<5	29	<5	<5	<5	<5	<5		<10	<5	<5	<5
	11/18/2008	< 25	9.9 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010	< 25	7.3 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A25	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/30/2010	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	11/4/2010	< 25	8.1 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A26	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	1.4 J	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	4/30/2010	< 25	< 25	< 50	< 100	< 5	< 5	1.6 J	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A27	11/1/2002							<0.5										
	7/29/2003		<20	<10	<10	<10	<5	<5	<5	<5	<5	<5	<5		<10	<5	<5	<5
	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010 (Dup)	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A28	5/3/2010 - SS	< 25	13 J	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010 - LF	< 25	18 J	< 50	< 100	< 5	< 5	1.6 J	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	11/3/2010 - SS	< 25	< 25	< 50	< 100	< 5	< 5	2.3	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	11/3/2010 - LF	< 25	< 25	< 50	< 100	< 5	< 5	2.4	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
MW-A29	11/18/2008	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
	5/3/2010	< 25	< 25	< 50	< 100	< 5	< 5	< 2	< 5	< 5	< 5	< 5	< 10	< 25	< 5	< 5	< 5	< 10
B40E1	11/14/2002							<1	<1	<1	<1	<1	<1			<1	<1	<1
B40E2	11/14/2002							<1	<1	<1	<1	<1	<1			<1	<1	<1
B40S1	11/14/2002							<1	<1	<1	<1	<1	<1			<1	<1	<1

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	4-Methyl-2-pentanone	Acetone	Acetonitrile	Acrolein	Acrylonitrile	Allyl chloride	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Butyl acetate	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane
Screening Value		2000	22000	130	0.042	0.045	0.65	5	88	54.4	80	80	8.7	NA	1000	5	100	48.5
B40S2	11/14/2002							<1	<1	<1	<1	<1	<1			<1	<1	<1
B40W1	11/14/2002							<1	<1	<1	<1	<1	<1			<1	<1	<1
B45CMW-3A	7/2/2003		<50		<50	<50		<1	<1		<1	<1	<1			<1	<1	<1
B45CMW-3B	6/26/2003		<50		<50	<50		<1	<1		<1	<1	<1			<1	<1	<1
B45CS1D	11/15/2002							<5										
B45CS2	11/14/2002							<5										
B45CS3D	11/20/2002							<0.5										
B45S1D	11/18/2002							<5										
B45S2	11/18/2002							29.4										
B45S3	11/18/2002							23.5										
B45S4	11/18/2002							<5										
	11/18/2002 (Dup)							<5										
B45S5D	11/19/2002							<5										
B45S6	11/18/2002							<5										
B45S7	11/19/2002							6.7										

Notes:

NA: Not available

 1/2RL > SV
 Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Chloroform	Chloromethane	Chloroprene	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	cis-1,4-Dichloro-2-butene	Cyclohexanone	Dibromochloromethane	Dibromomethane	Dichlorodifluoromethane	Diisopropyl ether	Ethyl acetate	Ethyl ether	Ethyl methacrylate	Ethylbenzene	Ethyl-tert-butyl ether	Heptane
Screening Value		80	190	14	70	0.43	0.0012	180000	80	8.2	390	830	33000	7300	3300	700	NA	NA
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003															1		
	11/19/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
MW-A3	11/4/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10		< 10	< 5	< 5	< 5		< 20
	6/26/2003	< 5	< 1		< 1	< 1				< 1	< 1	< 1				< 1		
	11/19/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	11/4/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10		< 10	< 5	< 5	< 5		< 20
MW-A15	7/2/2003	< 50	< 10		< 10	< 10				< 10	< 10	< 10				< 10		
	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
MW-A17	6/26/2003	< 5	< 1		< 1	< 1				< 1	< 1	< 1				< 1		
MW-A18	6/26/2003	< 5	< 1		< 1	< 1				< 1	< 1	< 1				< 1		
	7/29/2003	< 5	< 10		< 5	< 5				< 5	< 5				< 5	< 5		
MW-A22	11/1/2002															2.8		
	3/20/2003															< 0.5		
	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	5/3/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
MW-A23	7/2/2003															0.64		
	7/29/2003	< 5	< 10		< 5	< 5				< 5	< 5				< 5	< 5		
	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	5/3/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	48.7
MW-A25	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	4/30/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	11/4/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10		< 10	< 5	< 5	< 5		< 20
MW-A26	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	4/30/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
MW-A27	11/1/2002															< 0.5		
	7/29/2003	< 5	< 10		< 5	< 5				< 5	< 5				< 5	< 5		
	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	5/3/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	5/3/2010 (Dup)	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
MW-A28	5/3/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	83.4
	5/3/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	11/3/2010 - SS	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10		< 10	< 5	< 5	< 5		< 20
	11/3/2010 - LF	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10		< 10	< 5	< 5	< 5		< 20
MW-A29	11/18/2008	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
	5/3/2010	< 5	< 10	< 20	< 5	< 5	< 5	< 50	< 5	< 5	< 10	< 2	< 10	< 5	< 5	< 5	< 2	< 20
B40E1	11/14/2002	< 1	< 1		< 1	< 1			< 1	< 1	< 1					< 1		
B40E2	11/14/2002	< 1	< 1		< 1	< 1			< 1	< 1	< 1					< 1		
B40S1	11/14/2002	< 1	< 1		< 1	< 1			< 1	< 1	< 1					< 1		

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Chloroform	Chloromethane	Chloroprene	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	cis-1,4-Dichloro-2-butene	Cyclohexanone	Dibromochloromethane	Dibromomethane	Dichlorodifluoromethane	Diisopropyl ether	Ethyl acetate	Ethyl ether	Ethyl methacrylate	Ethylbenzene	Ethyl-tert-butyl ether	Heptane
Screening Value		80	190	14	70	0.43	0.0012	180000	80	8.2	390	830	33000	7300	3300	700	NA	NA
B40S2	11/14/2002	<1	<1		<1	<1			<1	<1	<1					<1		
B40W1	11/14/2002	<1	<1		<1	<1			<1	<1	<1					<1		
B45CMW-3A	7/2/2003	<5	<1		<1	<1				<1	<1	<1				<1		
B45CMW-3B	6/26/2003	<5	<1		<1	<1				<1	<1	<1				<1		
B45CS1D	11/15/2002															<5		
B45CS2	11/14/2002															<5		
B45CS3D	11/20/2002															<0.5		
B45S1D	11/18/2002															<5		
B45S2	11/18/2002															<5		
B45S3	11/18/2002															<5		
B45S4	11/18/2002															<5		
	11/18/2002 (Dup)															<5		
B45S5D	11/19/2002															<5		
B45S6	11/18/2002															<5		
B45S7	11/19/2002															<5		

Notes:

NA: Not available

1/2RL > SV
Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Hexachlorobutadiene	Hexachloroethane	Iodomethane	Isopropylbenzene	m,p-Xylenes	Methacrylonitrile	Methyl acetate	Methyl Methacrylate	Methyl tert-butyl ether	Methylacrylate	Methylene chloride	Naphthalene	n-Butylbenzene	n-Hexane	Nitrobenzene	n-Propylbenzene	o-Xylene
Screening Value		0.86	4.8	8.59	680	1200	1	37000	1400	12	1100	5	0.14	98.9	880	0.12	1300	1200
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003									11								
	11/19/2008	< 5	< 10	< 5	4.5 J	< 5	< 10		< 5	< 2	< 10	< 5	< 10	3 J	< 20	< 50	4.9 J	< 5
	11/4/2010	< 5	< 10	< 5	4.3 J		< 10	< 5	< 5	< 2	< 10	< 5	< 10	6.1	< 20	< 50	6.3	
MW-A3	6/26/2003	<1			5.5					5.1		<5	<5	<1			7.8	
	11/19/2008	< 5	< 10	< 5	3.3 J	< 5	< 10		< 5	< 2	< 10	< 5	< 10	1.2 J	< 20	< 50	3.7 J	< 5
	11/4/2010	< 5	< 10	< 5	4.3 J		< 10	< 5	< 5	< 2	< 10	< 5	< 10	3.8 J	< 20	< 50	2.1 J	
MW-A15	7/2/2003	<10			14					<10		<50	<50	<10			12	
	11/18/2008	< 5	< 10	< 5	1.9 J	1.3 J	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
MW-A17	6/26/2003	<1			<1					<1		<5	<5	<1			<1	
MW-A18	6/26/2003	<1			<1					<1		<5	<5	<1			<1	
	7/29/2003	<10			<5	<5	<5		<5	<10		4.8J	<10	<5			<5	<5
MW-A22	11/1/2002									<5								
	3/20/2003									<5								
	11/18/2008	< 5	< 10	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
	5/3/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
MW-A23	7/2/2003									<5								
	7/29/2003	<10			26	<5	<5		<5	<10		6J	<10	8.1			31	<5
	11/18/2008	< 5	< 10	< 5	9.83	< 5	< 10		< 5	< 2	< 10	< 5	< 10	3.7 J	< 20	< 50	7.11	< 5
	5/3/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
MW-A25	11/18/2008	< 5	< 10	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
	4/30/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
	11/4/2010	< 5	< 10	< 5	< 5		< 10	< 5	< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
MW-A26	11/18/2008	< 5	< 10	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
	4/30/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
MW-A27	11/1/2002									<5								
	7/29/2003	<10			<5	<5	<5		<5	<10		5.5J	<10	<5			<5	<5
	11/18/2008	< 5	< 10	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
	5/3/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
	5/3/2010 (Dup)	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
MW-A28	5/3/2010 - SS	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	2 J	< 5	< 20	< 50	< 5	
	5/3/2010 - LF	< 5	< 10	< 5	11.3		< 10		< 5	< 2	< 10	< 5	4.8 J	4.9 J	< 20	< 50	7.16	
	11/3/2010 - SS	< 5	< 10	< 5	27.2		< 10	< 5	< 5	< 2	< 10	< 5	6.8 J	< 5	< 20	< 50	31.8	
	11/3/2010 - LF	< 5	< 10	< 5	29.9		< 10	< 5	< 5	< 2	< 10	< 5	12.2	10.7	< 20	< 50	36.4	
MW-A29	11/18/2008	< 5	< 10	< 5	< 5	< 5	< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	< 5
	5/3/2010	< 5	< 10	< 5	< 5		< 10		< 5	< 2	< 10	< 5	< 10	< 5	< 20	< 50	< 5	
B40E1	11/14/2002	<1			<1	<1						<1	<1	<1			<1	<1
B40E2	11/14/2002	<1			<1	<1						<1	<1	<1			<1	<1
B40S1	11/14/2002	<1			<1	<1						<1	<1	<1			<1	<1

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Hexachlorobutadiene	Hexachloroethane	Iodomethane	Isopropylbenzene	m,p-Xylenes	Methacrylonitrile	Methyl acetate	Methyl Methacrylate	Methyl tert-butyl ether	Methylacrylate	Methylene chloride	Naphthalene	n-Butylbenzene	n-Hexane	Nitrobenzene	n-Propylbenzene	o-Xylene
Screening Value		0.86	4.8	8.59	680	1200	1	37000	1400	12	1100	5	0.14	98.9	880	0.12	1300	1200
B40S2	11/14/2002	<1			<1	<1						<1	<1	<1			<1	<1
B40W1	11/14/2002	<1			<1	<1						<1	<1	<1			<1	<1
B45CMW-3A	7/2/2003	<1			<1					<5		<5	<5	<1			<1	
B45CMW-3B	6/26/2003	<1			<1					<1		<5	5.3	<1			<1	
B45CS1D	11/15/2002									<5								
B45CS2	11/14/2002									<5								
B45CS3D	11/20/2002									<5								
B45S1D	11/18/2002									<5								
B45S2	11/18/2002									<5								
B45S3	11/18/2002									<5								
B45S4	11/18/2002									<5								
	11/18/2002 (Dup)									<5								
B45S5D	11/19/2002									<5								
B45S6	11/18/2002									<5								
B45S7	11/19/2002									<5								

Notes:

NA: Not available

1/2RL > SV
Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Pentachloroethane	p-Isopropyltoluene	Propionitrile	sec-Butylbenzene	Styrene	tert-Amyl methyl ether	tert-Butyl alcohol	tert-Butylbenzene	Tetrachloroethene	Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	trans-1,4-Dichloro-2-butene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate
Screening Value		0.75	786	NA	106	100	NA	NA	103	5	20.3	1000	100	NA	0.0012	5	1300	410
MW-A1	5/7/2001																	
	7/26/2001																	
	7/2/2003											<5						
	11/19/2008	< 20	< 5	< 50	4.1 J	< 5	< 2	< 25	1 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	11/4/2010	< 20	< 5	< 50	4.8 J	< 5			1.2 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A3	6/26/2003		5.4		5.1	<1			2.3	<1		<5	<1	<1		<1	<1	
	11/19/2008	< 20	< 5	< 50	2.1 J	< 5	< 2	< 25	1 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	11/4/2010	< 20	< 5	< 50	3.6 J	< 5			1.2 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A15	7/2/2003		<10		<10	<10			<10	<10		<50	<10	<10		<10	<10	
	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A17	6/26/2003		<1		<1	<1			<1	<1		<5	<1	<1		<1	<1	
MW-A18	6/26/2003		<1		<1	<1			<1	<1		<5	<1	<1		<1	<1	
	7/29/2003		<5	<5	<5	<5			<5	<5		<5	<5	<5	<5	<5	<5	<10
MW-A22	11/1/2002											<5						
	3/20/2003											<5						
	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A23	7/2/2003											<5						
	7/29/2003		<5	<5	12	<5			<5	<5		<5	<5	<5	<5	<5	<5	<10
	11/18/2008	< 20	< 5	< 50	2.8 J	< 5	< 2	< 25	1.2 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A25	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	4/30/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	11/4/2010	< 20	< 5	< 50	< 5	< 5			< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A26	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	1.4 J	< 5	< 10	< 5	< 5	< 10
	4/30/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A27	11/1/2002											<5						
	7/29/2003		<5	<5	<5	<5			<5	<5		<5	<5	<5	<5	<5	<5	<10
	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010 (Dup)	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A28	5/3/2010 - SS	< 20	< 5	< 50	< 5	< 5	< 2	< 25	1.3 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010 - LF	< 20	< 5	< 50	3.1 J	< 5	< 2	< 25	1.6 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	11/3/2010 - SS	< 20	< 5	< 50	8.6	< 5			1.6 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	11/3/2010 - LF	< 20	< 5	< 50	9.8	< 5			1.6 J	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
MW-A29	11/18/2008	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
	5/3/2010	< 20	< 5	< 50	< 5	< 5	< 2	< 25	< 5	< 5	< 20	< 5	< 5	< 5	< 10	< 5	< 5	< 10
B40E1	11/14/2002		<1		<1	<1			<1	<1		<1	<1	<1		1.1	<1	
B40E2	11/14/2002		<1		<1	<1			<1	<1		<1	<1	<1		<1	<1	
B40S1	11/14/2002		<1		<1	<1			<1	<1		<1	<1	<1		<1	<1	

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Pentachloroethane	p-Isopropyltoluene	Propionitrile	sec-Butylbenzene	Styrene	tert-Amyl methyl ether	tert-Butyl alcohol	tert-Butylbenzene	Tetrachloroethene	Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	trans-1,4-Dichloro-2-butene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate
Screening Value		0.75	786	NA	106	100	NA	NA	103	5	20.3	1000	100	NA	0.0012	5	1300	410
B40S2	11/14/2002		<1		<1	<1			<1	<1		<1	<1	<1		<1	<1	
B40W1	11/14/2002		<1		<1	<1			<1	<1		<1	<1	<1		<1	<1	
B45CMW-3A	7/2/2003		1		1.1	<1			<1	<1		<5	<1	<1		<1	<1	
B45CMW-3B	6/26/2003		<1		<1	<1			<1	<1		<5	<1	<1		<1	<1	
B45CS1D	11/15/2002											<5						
B45CS2	11/14/2002											<5						
B45CS3D	11/20/2002											<5						
B45S1D	11/18/2002											<5						
B45S2	11/18/2002											54.8						
B45S3	11/18/2002											18.6						
B45S4	11/18/2002											<5						
	11/18/2002 (Dup)											<5						
B45S5D	11/19/2002											<5						
B45S6	11/18/2002											<5						
B45S7	11/19/2002											10.1						

Notes:

NA: Not available

	1/2RL > SV
	Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Vinyl chloride	Xylenes, Total	TPH - GRO (C6 - C10)	TPH-DRO (C10 - C21)	TPH-ORO (C21 - C35)	#6 FUEL OIL (C10-C32)	Arsenic	Barium	Cadmium	Chromium	Mercury	Arsenic, Dissolved	Barium, Dissolved	Cadmium, Dissolved	Chromium, Dissolved	Mercury, Dissolved	1,2-Dibromomethane
Screening Value		2	10000	18100	34300	31800	NA	10	2000	5	100	2	10	2000	5	100	2	0.05
MW-A1	5/7/2001							44	680	<2	16	<0.2	20	470	<2	2.6	<0.2	
	7/26/2001							51	740	42 J	21	<0.2	27	490	<2	2.4	<0.2	
	7/2/2003		2.1				<500											
	11/19/2008	< 2	< 5	230 J	2780	556		89										
	11/4/2010	< 2	< 5															
MW-A3	6/26/2003	<1	<3				<100											
	11/19/2008	< 2	< 5	< 500	2790	493		23 J										
	11/4/2010	< 2	< 5															
MW-A15	7/2/2003	<10	<30				<100											
	11/18/2008	< 2	1.3 J	< 500	403	< 300												
MW-A17	6/26/2003	<1	<3				<100											
MW-A18	6/26/2003	<1	<3				<100											
	7/29/2003	<5																
MW-A22	11/1/2002		11				<100											
	3/20/2003		<1.5															
	11/18/2008	< 2	< 5	< 500	230 J	< 300												
	5/3/2010	< 2	< 5	< 500	200 J	< 300												
MW-A23	7/2/2003		2.6				<100											
	7/29/2003	<5																
	11/18/2008	< 2	< 5	2550	1040	290 J												
	5/3/2010	< 2	< 5	1600	868	220 J												
MW-A25	11/18/2008	< 2	< 5	< 500	220 J	< 300												
	4/30/2010	< 2	< 5	< 500	< 300	< 300												
	11/4/2010	< 2	< 5															
MW-A26	11/18/2008	< 2	< 5	< 500	684	270 J												
	4/30/2010	1.8 J	< 5	360 J	384	< 300												
MW-A27	11/1/2002		<1.5				<100											
	7/29/2003	<5																
	11/18/2008	< 2	< 5	< 500	220 J	< 300												
	5/3/2010	< 2	< 5	< 500	240 J	< 300												
	5/3/2010 (Dup)	< 2	< 5	210 J	270 J	< 300												
MW-A28	5/3/2010 - SS	< 2	< 5	3200	1820	500 J												
	5/3/2010 - LF	< 2	1.5 J	3510	1530	270 J												
	11/3/2010 - SS	< 2	1.1 J															
	11/3/2010 - LF	< 2	1.1 J															
MW-A29	11/18/2008	< 2	< 5	< 500	210 J	< 300												
	5/3/2010	< 2	< 5	< 500	< 300	< 300												
B40E1	11/14/2002	<1																<1
B40E2	11/14/2002	<1																<1
B40S1	11/14/2002	<1																<1

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Vinyl chloride	Xylenes, Total	TPH - GRO (C6 - C10)	TPH-DRO (C10 - C21)	TPH-ORO (C21 - C35)	#6 FUEL OIL (C10-C32)	Arsenic	Barium	Cadmium	Chromium	Mercury	Arsenic, Dissolved	Barium, Dissolved	Cadmium, Dissolved	Chromium, Dissolved	Mercury, Dissolved	1,2-Dibromomethane
Screening Value		2	10000	18100	34300	31800	NA	10	2000	5	100	2	10	2000	5	100	2	0.05
B40S2	11/14/2002	<1																<1
B40W1	11/14/2002	<1																<1
B45CMW-3A	7/2/2003	<1	<1.5				<100											
B45CMW-3B	6/26/2003	<1	<3				<100											
B45CS1D	11/15/2002		<5															
B45CS2	11/14/2002		<5															
B45CS3D	11/20/2002		<1.5															
B45S1D	11/18/2002		<5															
B45S2	11/18/2002		<5															
B45S3	11/18/2002		<5															
B45S4	11/18/2002		<5															
	11/18/2002 (Dup)		<5															
B45S5D	11/19/2002		<5															
B45S6	11/18/2002		<5															
B45S7	11/19/2002		8.4															

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,4-Dioxane	Chlorodibromomethane	Diesel #1	Diesel #2	Diesel (C7-C26)	Ethylene glycol	Gasoline (C6-C14)	Hydraulic fluid (C12-C33)	Isobutyl alcohol	Kerosene	Kerosene (C9-C16)	Lead	Methyl ethyl ketone (MEK)	Methyl iodide	Methyl isobutyl ketone	Mineral spirits (C7-C14)	MISC_TPH (C10-C40)
Screening Value		6.1	80	NA	NA	NA	73000	NA	NA	11000	NA	NA	15	7100	8.6	2000	NA	NA
MW-A1	5/7/2001											15	<5					
	7/26/2001											14	9.4					
	7/2/2003					<500			<500		<500						<500	19000
	11/19/2008																	
	11/4/2010																	
MW-A3	6/26/2003		<1			<100			<100		<100			<50		<50	<100	9500
	11/19/2008																	
	11/4/2010																	
MW-A15	7/2/2003		<10			<100			<100		<100			<500		<500	<100	810
	11/18/2008																	
MW-A17	6/26/2003		<1			<100			<100		<100			<50		<50	<100	160
MW-A18	6/26/2003		<1			<100			<100		<100			<50		<50	<100	210 J3J4
	7/29/2003	<5	<5				<10000							4.2 J	<5	<10		
MW-A22	11/1/2002					<100			<100		<100						<100	840
	3/20/2003																	
	11/18/2008																	
	5/3/2010																	
MW-A23	7/2/2003					<100			<100		<100						<100	3900
	7/29/2003	<5	<5				<10000							<5	<5	<10		
	11/18/2008																	
	5/3/2010																	
MW-A25	11/18/2008																	
	4/30/2010																	
	11/4/2010																	
MW-A26	11/18/2008																	
	4/30/2010																	
MW-A27	11/1/2002					<100			<100		<100						<100	1300
	7/29/2003	<5	<5				<10000							<5	<5	<10		
	11/18/2008																	
	5/3/2010																	
	5/3/2010 (Dup)																	
MW-A28	5/3/2010 - SS																	
	5/3/2010 - LF																	
	11/3/2010 - SS																	
	11/3/2010 - LF																	
MW-A29	11/18/2008																	
	5/3/2010																	
B40E1	11/14/2002			<1000	<1000					<1000								
B40E2	11/14/2002			<1000	<1000					<1000								
B40S1	11/14/2002			<1000	<1000					<1000								

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	1,4-Dioxane	Chlorodibromomethane	Diesel #1	Diesel #2	Diesel (C7-C26)	Ethylene glycol	Gasoline (C6-C14)	Hydraulic fluid (C12-C33)	Isobutyl alcohol	Kerosene	Kerosene (C9-C16)	Lead	Methyl ethyl ketone (MEK)	Methyl iodide	Methyl isobutyl ketone	Mineral spirits (C7-C14)	MISC_TPH (C10-C40)
Screening Value		6.1	80	NA	NA	NA	73000	NA	NA	11000	NA	NA	15	7100	8.6	2000	NA	NA
B40S2	11/14/2002			<1000	<1000					<1000								
B40W1	11/14/2002			<1000	<1000					<1000								
B45CMW-3A	7/2/2003		<1			<100			<100		<100			<50		<50	<100	9500
B45CMW-3B	6/26/2003		<1			<100			<100		<100			<50		<50	<100	1400
B45CS1D	11/15/2002			<1000	<1000			<1000		<1000								
B45CS2	11/14/2002			<1000	<1000			<1000		<1000								
B45CS3D	11/20/2002																	
B45S1D	11/18/2002			<1000	<1000			<1000		<1000								
B45S2	11/18/2002			<1000	<1000			15310		<1000								
B45S3	11/18/2002			<1000	<1000			2760		<1000								
B45S4	11/18/2002			<1000	<1000			<1000		<1000								
	11/18/2002 (Dup)			<1000	<1000			<1000		<1000								
B45S5D	11/19/2002			<1000	<1000			<1000		<1000								
B45S6	11/18/2002			<1000	<1000			<1000		<1000								
B45S7	11/19/2002			<1000	<1000			41410		<1000								

Notes:

NA: Not available

1/2RL > SV
Detect > SV

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Motor oil (C16-C33)	Stoddard solvent	TPH (GC/FID) high fraction	TPH (GC/FID) low fraction
Screening Value		NA	NA	NA	NA
MW-A1	5/7/2001				
	7/26/2001				
	7/2/2003	<500			1900
	11/19/2008				
	11/4/2010				
MW-A3	6/26/2003	<100			3800
	11/19/2008				
	11/4/2010				
MW-A15	7/2/2003	<100			610
	11/18/2008				
MW-A17	6/26/2003	<100			<100
MW-A18	6/26/2003	<100			<100
	7/29/2003				
MW-A22	11/1/2002	<100			1700
	3/20/2003				190
	11/18/2008				
	5/3/2010				
MW-A23	7/2/2003	<100			3400
	7/29/2003				
	11/18/2008				
	5/3/2010				
MW-A25	11/18/2008				
	4/30/2010				
	11/4/2010				
MW-A26	11/18/2008				
	4/30/2010				
MW-A27	11/1/2002	<100			<100
	7/29/2003				
	11/18/2008				
	5/3/2010				
	5/3/2010 (Dup)				
MW-A28	5/3/2010 - SS				
	5/3/2010 - LF				
	11/3/2010 - SS				
	11/3/2010 - LF				
MW-A29	11/18/2008				
	5/3/2010				
B40E1	11/14/2002	<1000	<1000		
B40E2	11/14/2002	<1000	<1000		
B40S1	11/14/2002	<1000	<1000		

Table A3-1
Comprehensive Groundwater Analytical Data for Area 1
Boeing Tract 1, Hazelwood, Missouri

Well ID	Date	Motor oil (C16-C33)	Stoddard solvent	TPH (GC/FID) high fraction	TPH (GC/FID) low fraction
Screening Value		NA	NA	NA	NA
B40S2	11/14/2002	<1000	<1000		
B40W1	11/14/2002	<1000	<1000		
B45CMW-3A	7/2/2003				220
B45CMW-3B	6/26/2003				160
B45CS1D	11/15/2002	<1000	<1000		
B45CS2	11/14/2002	<1000	<1000		
B45CS3D	11/20/2002			<100	<100
B45S1D	11/18/2002	<1000	<1000		
B45S2	11/18/2002	<1000	<1000		
B45S3	11/18/2002	<1000	<1000		
B45S4	11/18/2002	<1000	<1000		
	11/18/2002 (Dup)	<1000	<1000		
B45S5D	11/19/2002	<1000	<1000		
B45S6	11/18/2002	<1000	<1000		
B45S7	11/19/2002	<1000	<1000		

Notes:

NA: Not available

1/2RL > SV

Detect > SV

Table A3-2
LNAPL Summary for Area 1 Wells
Boeing Tract 1, Hazelwood, Missouri

Well ID	LNAPL		November-2008			April-2010 [#]			October-November 2010			March 2011		
	at Well Installation	Since 92	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)	Date	LNAPL Thickness (ft)	Depth to Water (ft btoc)
MW-A1	Yes	Yes	11/18/2008	0.01	4.84	4/13/2010	Sheen	4.88	11/3/2010	Sheen	5.26	3/7/2011	NA	4.82
MW-A3	Yes	Yes	11/18/2008	0.01	3.87	4/13/2010	0.01	4.06	11/3/2010	Sheen	4.28	3/7/2011	NA	2.87
MW-A25	No	Yes	NA	NA	NA	NA	NA	NA	11/3/2010	Sheen	4.36	3/7/2011	NA	3.84
MW-A26	No	Yes	NA	NA	NA	NA	NA	NA	11/3/2010	Sheen	6.21	3/7/2011	NA	4.86
MW-A27	No	Yes	NA	NA	NA	4/13/2010	0.01	3.63	NA	NA	NA	3/7/2011	NA	3.47

Notes

NA: LNAPL not observed

#: MW-A27 had LNAPL or sheen during gauging and did not have any LNAPL during sampling two weeks later

ft: feet

btoc: below top of casing

APPENDIX D
DEVELOPMENT OF GROUNDWATER TARGET LEVELS

DEVELOPMENT OF GROUNDWATER TARGET LEVELS BOEING TRACT 1, HAZELWOOD, MISSOURI

This appendix summarizes the approach to develop groundwater target levels for the Boeing Tract 1 site for the following two pathways for the selected chemicals of concern (SCOCs):

- (i) Groundwater protection pathway, and
- (ii) Indoor inhalation of vapors from groundwater.

1.0 SELECTED CHEMICALS OF CONCERN

Groundwater target levels will be developed for chemicals that have consistently exceeded the conservative screening values (SVs). These SVs have previously been presented in the memorandum *Chemical in Groundwater Exceeding Screening Values* (RAM Group, 2010) and are based on the following hierarchy:

- Maximum contaminant levels (MCLs),
- Regional screening levels (RSLs) tap water, and
- Missouri risk-based corrective action (MRBCA) default target levels (DTLs).

The groundwater data collected during November 2008, April 2010, November 2010, and July 2011 sampling events were evaluated to identify the SCOCs.

Based on the comparison of detected concentrations with the SVs, 19 chemicals including (14 volatile organic compounds (VOCs), 2 total petroleum hydrocarbons (TPHs), and 3 metals) in 12 areas/sub-areas exceeded the SVs. These chemicals are shown in Table d-1.

Of the 19 chemicals, two chemicals (methylene chloride and bis(2-ethylhexyl)phthalate) in Sub-area 6B are not of concern as discussed in the previous memo (RAM Group, 2010). One chemical (dichlorodifluoromethane) in Sub-area 6B is also not of concern since this chemical was detected in only one well. Note no target levels will be developed for the two TPH groups in Sub-area 2B because benzene and naphthalene have been selected as SCOCs. Further the composition and hence the risk-based target levels for TPH will change over time due to the weathering of the TPH.

Based on the above, Table d-2 presents the final chemicals that exceed groundwater SVs in each area/sub-area and are discussed below.

1.1 Organic Chemicals of Concern

In the Sub-area 2B and 6B, the SCOCs will include all the ten organic chemicals that exceeded the SVs. The specific chemicals are listed in Table 1. The exceedances in each of the other sub-areas are presented below.

Area 1 – 1,2-Dibromomethane (SV = 0.05 µg/L)

- A total of 23 samples have been collected from 10 monitoring wells that have since November 2008.
- Of these, only one sample collected from MWA-1 during the November 2008 sampling event had a detected concentration of 1 µg/L.
- The reporting limit of all the not-detected samples was 5 µg/L which exceeds the SV.

Based on the above, groundwater target levels will be developed for 1,2-dibromomethane in Area 1.

Area 1 – Naphthalene (SV = 0.14 µg/L)

- Total of 23 samples were collected from 10 wells since November 2008.
- Samples collected only from MW-A28 during the May 2010 and November 2010 sampling events had detected concentrations. The maximum detected concentration was 12.2 µg/L.
- Samples collected from several wells close to MW-A28 showed concentrations below the reporting limit. However, the reporting limit was 10 µg/L that exceeds the SV.

Based on the above, groundwater target levels will be developed for naphthalene in Area 1.

Sub-area 2C – TCE (SV = 5 µg/L)

- There are two monitoring wells (MW-A12 and MW-A13) that have been sampled since November 2008.
- Two samples were collected from MW-A12. One sample had a detected concentration of 3.7 µg/L, the concentration in the second was below the reporting limit that was less than that the SV.
- Three samples were collected from MW-A13. One sample had a detected concentration 8.1 µg/L. The concentration in the remaining two samples was below the reporting limit that was below the SV.
- During the most recent sampling event, the concentration in MW-A13 was below the reporting limit of 5 µg/L and MW-A12 was not sampled.

Based on the above, there is no consistent exceedance of TCE in Sub-area 2C.

Sub-area 3A – Naphthalene (SV = 0.14 µg/L)

- There are two monitoring wells (B41MW-18 and B42N6) that have been sampled since 2008. B42N6 was essentially a replacement well of B42N5 which was

destroyed during the excavation activities in 2005. B42N6 is located 15 feet down gradient to B42N5 screened in the same zone.

- Two samples were collected from B41MW-18 and had concentrations below the reporting limit of 10 µg/L.
- Three samples were collected from B42N6 and naphthalene was detected in one sample at 2 µg/L which is greater than SV, but this concentration is estimated with a “J” qualifier. Other two concentrations were below the reporting limit of 10 µg/L.

Based on the above, there is no consistent exceedance of naphthalene in Sub-area 3A.

Sub-area 3A – Vinyl Chloride (SV = 2 µg/L)

- There are two monitoring wells (B41MW-18 and B42N6) that have been sampled since 2008. B42N6 was essentially a replacement well of B42N5 which was destroyed during the excavation activities in 2005. B42N6 is located 15 feet downgradient to B42N5 screened in the same zone.
- Two samples were collected from B41MW-18 and had concentrations below the reporting limit of 2 µg/L.
- Three samples were collected from B42N6 and had detected vinyl chloride concentrations of 7.75, 1.2, and 27.2 µg/L. Two samples exceeded the SV. These concentrations are comparable to the concentration of 12 µg/L detected in B42N5 in July 2003.
- Additionally, cis-1,2-dichloroethene in B42N6 was measured at concentrations of 16.8, <5, and 7.6 µg/L which did not exceed the SV of 70 µg/L. Further, these concentrations are significantly lower than the concentrations of 760 µg/ detected in B42N5 in July 2003.
- The sharp decrease in concentration of cis-1,2-dichloroethene is indicative of the success of the excavation activities in 2005.
- It is anticipated the concentrations will continue to decrease because of the absence of any source and on-going natural attenuation. This will be further confirmed during the CMS monitoring.

Based on the above, there is no consistent exceedance of vinyl chloride in Sub-area 3A.

Sub-area 3D – 1,1-Dichloroethane (SV = 2.4 µg/L)

- There are two monitoring wells (B41MW-5 and B41S5D) that have been sampled since November 2008.
- Two samples were collected from B41MW-5 and had detected concentrations of 13.8 and 2 µg/L. One sample exceeded the SV, however, the recent sample result did not exceed the SV.
- Three samples were collected from B41S5D. One sample had a detected

concentration of 5.72 µg/L which exceeded the SV. The recent sample had concentration below the reporting limit of 5 µg/L.

Based on the above, there is no consistent exceedance of 1,1-dichloroethane in Sub-area 3D.

Sub-area 6A – TCE (SV = 5 µg/L)

- There is one monitoring well (MW1) that have been sampled since November 2008.
- Three samples were collected from MW1. One sample had a detected concentration of 54.5 µg/L; however, the recent two samples had concentrations below the reporting limit of 5 µg/L.
- Eight samples collected from MW1 during the previous sampling events (July 2000 – July 2003) had concentrations below the reporting limit of 1 µg/L or 5 µg/L.

Based on the above, there is no consistent exceedance of TCE in Sub-area 6A.

Sub-area 6D – PCE (SV = 5 µg/L)

- There are two monitoring wells (MW6 and MW6D) that have been sampled since November 2008.
- Seven samples including three duplicates were collected from MW6 during four sampling events. Of these four samples (excluding duplicates), three samples had detected concentrations with maximum detected concentration of 6.2 µg/L. However, the most recent sample had a concentration below the reporting limit of 5 µg/L.
- Four samples were collected from MW6D during four sampling events. All four samples had concentrations below the reporting limit of 5 µg/L.

Based on the above evaluation, there is no consistent exceedance of PCE in Sub-area 6D.

Sub-area 8A – 1,1-Dichloroethane (SV = 2.4 µg/L)

- There are two monitoring wells (MW10S and MW10D) which are located close to the most downgradient property boundary.
- Six samples including two snap sample duplicates were collected from each of MW10S and MW10D since November 2008.
- Five samples had detected concentrations of 1,1-dichloroethane with maximum detected concentration of 3.5 µg/L with a “J” qualifier. Of these five samples, four concentrations were below the SV. Further, the most recent sample had a detected concentration of 1.6 µg/L which is below the SV.
- Six samples from MW10D had 1,1-dichloroethane concentrations below the

reporting limit of 5 µg/L.

Based on the above, there is no consistent exceedance of 1,1-dichloroethane in Sub-area 8A.

Sub-area 8A – TCE (SV = 5 µg/L)

- There are two monitoring wells (MW10S and MW10D) which have been sampled since November 2008.
- Of the six samples (including two Snap sample duplicates) collected from MW10S, only one sample had a detected TCE concentration of 57.4 µg/L. Recent three samples had TCE concentrations below the reporting limit of 5 µg/L.
- Of the six samples (including two Snap sample duplicates) collected from MW10D, five samples had detected concentrations of TCE with maximum concentration of 15.4 µg/L. However, the most recent sample had a TCE concentration below the reporting limit of 5 µg/L.
- There was TCE a vapor degreaser within Building 220 that was removed in 1998.
- Twenty two samples collected from MW10S and MW10D during the sampling events (September 2000 – June 2003) had one detected concentration of 1.2 µg/L. The other 21 samples had concentrations below the reporting limit of 1 µg/L or 5 µg/L.

Based on the above, currently there is no consistent exceedance of TCE in Sub-area 8A.

1.2 Inorganic Chemicals of Concern

Area 1, Sub-areas 2A, 2B, 3H, 6B, 6C, 6D, and 8A – Arsenic (SV = 10 µg/L)

- As discussed in the previous memo (RAM Group, 2010), arsenic is not considered a COC.

Sub-area 6C – Hexavalent Chromium (SV = 0.043 µg/L)

- There are five monitoring wells (B25MW1, MW5CS, MW5DS, MW8AS, and MW8AD) that have been sampled since November 2008.
- Total of five samples were collected from five monitoring wells during the November 2008 sampling event and were analyzed for total hexavalent chromium. Of the five samples, three samples had detected concentrations (4 µg/L, 5 µg/L, and 7 µg/L) exceeding the SV. Two samples had concentrations below the reporting limit of 5 µg/L.
- Ten samples were collected from four wells during the April 2010 and October 2010 sampling events and were analyzed for dissolved hexavalent chromium. All of the ten sample concentrations below the reporting limit of 5 µg/L.
- Solid Waste Management Unit 30 (SWMU 30) was located in this area with

activities such as chemical etching, a spill containment area, and a metal plating shop inside Building 27. These processes could be the source of chromium.

Based on the above, hexavalent chromium will be considered a COC for developing target levels for the groundwater protection pathway.

Sub-areas 3D, 3H, 6B, 6C, and 8A – Manganese (SV = 880 µg/L)

- Fifty three samples from 17 wells in Sub-areas 3D, 3H, 6B, 6C, and 8A were analyzed and had detected concentrations. Of these samples, 41 samples exceeded the SV of 880 µg/L.
- The detected concentrations ranged from 9.6 µg/L to 7,290 µg/L with the following distribution:
 - Below 880 µg/L 12 samples
 - > 880 µg/L – 2,500 µg/L 27 samples
 - > 2,500 µg/L – 5,000 µg/L 13 samples
 - > 5,000 µg/L 1 sample
- Manganese compounds naturally occur in the earth's crust. The anthropogenic sources of manganese can be antiknock agents, antiseptics, catalysts, dry cells, fertilizers, pesticides. The source of manganese has not been identified at the five sub-areas and could be naturally occurring.
- There were no spatial and temporal trends indicative of a source area.
- Manganese is not volatile.

Based on above, manganese is not considered a COC for developing target level for the groundwater protection pathway.

1.3 Selected Chemicals of Concern with Half the Reporting Limits Greater than Screening Values

Half the reporting limits of the all chemicals analyzed were compared with SVs. The chemicals with half the reporting limits greater than SVs were identified for each of areas/sub-areas and reviewed whether those chemicals were also considered in the risk assessment (RAM Group, 2004). Except for Sub-area 2B and 6B, no other COCs were identified in any areas/sub-areas to be considered for developing target levels.

1.4 Summary of Selected Chemicals of Concern

Based on above, the groundwater target levels will be developed for the following SCOCs in five area/sub-areas:

SCOCs	SV µg/L	Source	Area 1	Sub- area 2B	Sub-area 6B	Sub-area 6C
Hexavalent chromium	0.04	RSL				X
1,1,2-Trichloroethane	5	MCL		X		
1,1-Dichloroethane	2.4	RSL			X	

1,1-Dichloroethylene	7	MCL		X	X	
1,2-Dibromomethane	0.05	MCL	X			
Benzene	5	MCL			X	
cis-1,2-Dichloroethylene	70	MCL		X	X	
Naphthalene	0.14	RSL	X	X		
PCE	5	MCL		X	X	
trans-1,2-Dichloroethylene	100	MCL			X	
TCE	5	MCL		X	X	
Vinyl chloride	2	MCL		X	X	

X: SCOCs RSL: Regional screening level (USEPA, June 2011)

Note in Area 1 the runaway protection area, no buildings can be built. Therefore, only target levels for groundwater protection pathway will be developed.

2.0 GROUNDWATER TARGET LEVELS

2.1 Groundwater Protection Pathway

The target levels for the groundwater protection pathway will be developed by considering a hypothetical point of exposure (POE) located at the downgradient property boundary. The allowable concentration at the POE will be the chemical specific SV. This condition will ensure that any offsite migration will be at concentrations below the screening levels.

Using the SV as the target concentration at the POE and dilution attenuation factors (DAFs) calculated using the Domenico's model, the groundwater target levels at several monitoring points between the source(s) and the POE will be calculated. These monitoring points are referred to as the point of demonstration (POD) wells. The calculated groundwater target levels at the POE and the PODs will be compared to the measured groundwater concentrations at the wells. Further details of this comparison and the decisions that will be made based on the comparison will be discussed in detail in the CMS report.

2.2 Indoor Inhalation of Vapors from Groundwater

The target levels for the indoor inhalation of vapors from groundwater will be developed using the Johnson & Ettinger (J&E) model presented in the *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (USEPA, 2004). The target levels for this pathway will be developed only for the volatile chemical defined as a chemical with Henry's law constant (H) greater than 1×10^{-5} atmospheric-cubic meters per mole ($\text{atm} \cdot \text{m}^3/\text{mol}$) and a molecular weight less than or equal to 200 g/mole.

RAM Group is currently compiling the data that will be used to develop the target levels. Other than the toxicity values, most of the inputs will be consistent with the risk assessments previously completed for this site.

Table D-1
All Chemicals that Exceed Groundwater Screening Values
November 2008, April 2010, November 2010, and July 2011
Boeing Tract 1, Hazelwood, Missouri

COCs	Area 1	Sub-area 2A	Sub-area 2B	Sub-area 2C	Sub-area 3A	Sub-area 3D	Sub-area 3H	Sub-area 6A	Sub-area 6B	Sub-area 6C	Sub-area 6D	Sub-area 8A
1,1-Dichloroethane						X			X			X
1,1-Dichloroethene									X			
1,1,2-Trichloroethane			X									
1,2-Dibromoethane	X											
Benzene									X			
cis-1,2-Dichloroethene			X						X			
Dichlorodifluoromethane									X			
Methylene chloride									X			
Naphthalene	X		X									
Tetrachloroethene (PCE)			X						X		X	
trans-1,2-Dichloroethene									X			
Trichloroethene (TCE)			X	X				X	X			X
Vinyl chloride			X		X				X			
Bis(2-ethylhexyl)phthalate									X			
Total Organics	2	0	6	1	1	1	0	1	11	0	1	2
TPH-GRO			X									
TPH-DRO			X									
Total TPH	0	0	2	0	0	0	0	0	0	0	0	0
Arsenic, total	X	X	X				X		X	X	X	X
Arsenic, dissolved		X	X						X			
Chromium, hexavalent										X		
Manganese, total						X	X		X	X		X
Manganese,dissolved							X		X	X		X
Total Metals	1	2	2	0	0	1	3	0	4	4	1	3
TOTAL COCs	3	2	10	1	1	2	3	1	15	4	2	5

Table D-2
Final Chemicals that Exceed Groundwater Screening Values
November 2008, April 2010, November 2010, and July 2011
Boeing Tract 1, Hazelwood, Missouri

COCs	Area 1	Sub-area 2A	Sub-area 2B	Sub-area 2C	Sub-area 3A	Sub-area 3D	Sub-area 3H	Sub-area 6A	Sub-area 6B	Sub-area 6C	Sub-area 6D	Sub-area 8A
1,1-Dichloroethane						X			X			X
1,1-Dichloroethene									X			
1,1,2-Trichloroethane			X									
1,2-Dibromoethane	X											
Benzene									X			
cis-1,2-Dichloroethene			X						X			
Naphthalene	X		X									
Tetrachloroethene (PCE)			X						X		X	
trans-1,2-Dichloroethene									X			
Trichloroethene (TCE)			X	X				X	X			X
Vinyl chloride			X		X				X			
Total Organics	2	0	6	1	1	1	0	1	8	0	1	2
Arsenic, total	X	X	X				X		X	X	X	X
Arsenic, dissolved		X	X						X			
Chromium, hexavalent										X		
Manganese, total						X	X		X	X		X
Manganese,dissolved							X		X	X		X
Total Metals	1	2	2	0	0	1	3	0	4	4	1	3
TOTAL COCs	3	2	8	1	1	2	3	1	12	4	2	5

APPENDIX E
UPDATE OF RISKS

APPENDIX E UPDATE OF RISKS

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Attachments

Tables for Updated Risks for Non-residential Worker and Construction Worker

E.1 INTRODUCTION

This appendix presents the updated risks for each area/sub-area and each receptor. The risks included in the RAM risk assessment report (RAM, 2004) were updated for the “factors” approved by MDNR and do not represent any changes not approved or agreed to by MDNR. Specifically, these factors include:

1. Changes in toxicity values and exposure factors,
2. Changes in TPH methodology, and
3. Changes in concentrations based on interim actions.

The effect of each of above factors on the risks and the combined effect of all the factors on the risks are presented in Tables E-1 and E-2 for non-residential worker and construction worker, respectively. In these tables, the second and seventh columns entitled “2004 Risk” present the cumulative carcinogenic and non-carcinogenic risks included in the RAM risk assessment, respectively.

Each of above three factors is discussed below.

E.2 CHANGES IN TOXICITY VALUES AND EXPSOURE FACTORS

As per the MDNR’s request, e-mail dated July 6, 2009, the risks in the RAM risk assessment for each area/sub-area were recalculated using revised toxicity values and exposure factors. Two memos (RAM Group, 2009c,d) present the changes in exposure factors and toxicity values, and their impact on the calculated risks. Per MDNR’s comments, the exposure factors changed only for the construction worker. Hence, the risks for construction worker were recalculated using the revised toxicity values and exposure factors. The risks for non-residential worker were recalculated using the revised toxicity values only since there was no change in the exposure factors.

The revised risks due to changes in toxicity values and exposure factors for each area/sub-area are tabulated in the third and eighth columns in Tables E-1 and E-2. As an example, with reference to Table E-1, for Sub-area 2B and non-residential worker the cumulative carcinogenic risk of $1.19\text{E-}5$ includes the effect of changes in toxicity values only (all other factors same as the RAM risk assessment).

Similarly, with reference to Table E-2, for Sub-area 2B and construction worker the cumulative carcinogenic risk of $3.34\text{E-}4$ is the revised carcinogenic risk for all COCs due to changes in toxicity values and exposure factors.

E.3 CHANGES IN TPH METHODOLOGY

As per the RAM Group (2010a), the changes in the TPH methodology affect the non-carcinogenic risks only because the TPH fractions are not considered carcinogenic. The primary change is the use of solubility limits for TPH concentrations that exceed the solubility limits.

This change affected the risks for (i) indoor inhalation of vapors from groundwater by the non-residential worker, and (ii) outdoor inhalation of vapors from groundwater by the construction worker.

For the area/sub-areas in which the recalculated cumulative risks in Section E.2 exceeded the target risk levels, the risks for indoor and outdoor inhalation of vapors from groundwater were recalculated as per the RAM Group (2010a).

The updated risks due to changes in TPH methodology are shown in the ninth column in Tables E-1 and E-2. With reference to Table E-1, for Sub-area 2B and non-residential worker the cumulative non-carcinogenic risk reduced from 96 to 0.72. Clearly, the representative concentrations used in the risk calculation significantly exceeded the solubility limits. With reference to Table E-2, for Sub-area 2B and construction worker the cumulative non-carcinogenic risk reduced from 11 to 4.6.

E.4 CHANGES IN CONCENTRATIONS BASED ON INTERIM ACTION

As an interim action, impacted soil was excavated in five sub-areas (2B, 3A, 3E, 6B, and 8B). Refer to Table E-3. These soil removal actions resulted in a change in the representative soil concentrations as presented in Table B-1 of the CMS Work Plan (RAM Group, 2010e) and included as Appendix B of this document.

The updated risks due to changes based on interim action are shown in the fifth and tenth columns in Tables E-1 and E-2. With reference to Table E-1, for Sub-area 2B and non-residential worker, the cumulative carcinogenic risk of $7.35\text{E-}6$ is the updated risks due to changes based on interim action. With reference to Table E-2, for Sub-area 2B and construction worker the cumulative carcinogenic risk of $3.35\text{E-}4$ is the update risks due to changes based on interim action.

E.5 FINAL UPDATED RISKS

The tables presenting the recalculated risks based on the combined effect of the three factors are presented as an attachment to this appendix. For ease of cross-reference with the RAM risk assessment, the numerical number of tables has been retained as in the RAM risk assessment. For example, Table 2-9(R) corresponds to Table 2-9(R) in the RAM risk assessment. The footers on this table are different (September 2004 vs. March 2011) and help distinguish the table.

The sixth and eleventh columns in Tables E-1 and E-2 present the recalculated risks based on the combined effect of the three factors. These risks are tabulated in Table 2-1 of this document as the revised risks and are used in the focused CMS.

Table E-1
Summary of Updated Risks Adjusted for Toxicity Values, TPH, and Interim Action for Non-residential Worker
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Non-residential Worker									
	IELCR					HI				
	2004 RA	Chagnes Due to			Final Risk	2004 RA	Chagnes Due to			Final Risk
		Toxicity	TPH	Interim Action			Toxicity	TPH	Interim Action	
Area 1 (Avg.)	N/A	N/A	---	---	N/A	N/A	N/A	---	---	N/A
Sub-area 2A	5.97E-08	3.63E-08	---	---	3.63E-08	22	22	0.052	---	0.052
Sub-area 2B	7.57E-06	1.19E-05	---	7.35E-06	7.35E-06	96	96	0.72	0.72	0.72
Sub-area 2C	2.02E-08	1.21E-08	---	---	1.21E-08	0.95	0.95	---	---	0.95
Sub-area 3A	7.90E-08	1.40E-08	---	1.44E-08	1.44E-08	2.6	2.6	0.017	0.017	0.017
Sub-area 3B	3.35E-09	2.01E-09	---	---	2.01E-09	0.31	0.31	---	---	0.31
Sub-area 3C	2.00E-08	1.20E-08	---	---	1.20E-08	77	77	0.033	---	0.033
Sub-area 3D	2.93E-08	1.25E-08	---	---	1.25E-08	0.075	0.075	---	---	0.075
Sub-area 3E	4.31E-08	2.60E-08	---	7.48E-09	7.48E-09	10	10	0.049	0.048	0.048
Sub-area 3F	NA	NA	---	---	NA	0.86	0.86	---	---	0.86
Sub-area 3G	6.02E-08	3.61E-08	---	---	3.61E-08	2.8	2.8	0.011	---	0.011
Sub-area 3H	NA	NA	---	---	NA	0.70	0.70	---	---	0.70
Area 4	2.17E-10	1.10E-10	---	---	1.10E-10	0.47	0.47	---	---	0.47
Area 5	NA	NA	---	---	NA	0.00053	0.00053	---	---	0.00053
Sub-area 6A	1.12E-10	6.73E-11	---	---	6.73E-11	0.054	0.054	---	---	0.054
Sub-area 6B	1.44E-06	1.92E-07	---	1.95E-07	1.95E-07	7.9	7.9	0.0063	0.0063	0.0063
Sub-area 6C	7.03E-08	2.33E-08	---	---	2.33E-08	4.1	4.1	0.0038	---	0.0038
Sub-area 6D	2.99E-10	3.08E-09	---	---	3.08E-09	0.00014	0.00014	---	---	0.00014
Area 7	N/A	N/A	---	---	N/A	N/A	N/A	---	---	N/A
Sub-area 8A	2.37E-08	9.39E-09	---	---	9.39E-09	0.00031	0.00004	---	---	0.00004
Sub-area 8B	NA	NA	---	---	NA	55	55	0.0029	---	0.0029
Sub-area 8C	NA	NA	---	---	NA	0.064	0.064	---	---	0.064
Area 9	1.79E-11	1.79E-11	---	---	1.79E-11	0.19	0.19	---	---	0.19

Notes:

Number in bold exceeds the cumulative acceptable target level.

IELCR: Individual excess lifetime cancer risk

HI: Hazard index

NA: Not available

N/A: Not applicable

Table E-2
Summary of Updated Risks Adjusted for Toxicity Values, Exposure Factors, TPH, and Interim Action for Construction Worker
Boeing Tract 1, St. Louis, Missouri

Area/ Sub-area	Construction Worker									
	IELCR					HI				
	2004 RA	Chagnes Due to			Final Risk	2004 RA	Chagnes Due to			Final Risk
		Toxicity and Exposure Factors	TPH	Interim Action			Toxicity and Exposure Factors	TPH	Interim Action	
Area 1 (Avg.)	1.87E-07	3.76E-07	---	---	3.76E-07	0.083	0.16	---	---	0.16
Sub-area 2A	3.52E-07	5.57E-07	---	---	5.57E-07	0.31	1.6	0.19	---	0.19
Sub-area 2B	1.89E-05	3.36E-04	---	3.35E-04	3.35E-04	3.1	11	4.6	4.6	4.6
Sub-area 2C	3.92E-08	9.89E-08	---	---	6.05E-08	0.047	0.15	---	---	0.15
Sub-area 3A	4.52E-08	6.05E-08	---	6.05E-08	6.05E-08	0.055	0.33	---	0.35	0.35
Sub-area 3B	4.66E-10	1.76E-09	---	---	1.76E-09	0.0071	0.039	---	---	0.039
Sub-area 3C	2.34E-08	5.88E-08	---	---	5.88E-08	1.3	9.2	0.047	---	0.047
Sub-area 3D	1.17E-07	2.71E-07	---	---	2.71E-07	0.048	0.066	---	---	0.066
Sub-area 3E	8.02E-10	3.02E-09	---	8.67E-10	8.67E-10	0.12	0.72	---	0.72	0.72
Sub-area 3F	NA	NA	---	---	NA	0.008	0.059	---	---	0.059
Sub-area 3G	9.38E-08	2.37E-07	---	---	2.37E-07	0.12	0.33	---	---	0.33
Sub-area 3H	6.35E-13	2.69E-12	---	---	2.69E-12	0.0058	0.040	---	---	0.040
Area 4	2.60E-06	5.40E-06	---	---	5.40E-06	0.014	0.042	---	---	0.042
Area 5	6.37E-08	8.17E-08	---	---	8.17E-08	0.013	0.022	---	---	0.022
Sub-area 6A	5.33E-08	6.85E-08	---	---	6.85E-08	0.0089	0.014	---	---	0.014
Sub-area 6B	2.44E-05	5.07E-05	---	5.07E-05	5.07E-05	0.17	0.90	---	0.90	0.90
Sub-area 6C	8.36E-08	1.18E-07	---	---	1.18E-07	0.060	0.21	---	---	0.21
Sub-area 6D	8.25E-08	2.95E-07	---	---	2.95E-07	0.013	0.018	---	---	0.018
Area 7	N/A	N/A	---	---	N/A	N/A	N/A	---	---	N/A
Sub-area 8A	1.02E-07	1.35E-07	---	---	1.35E-07	0.020	0.020	---	---	0.020
Sub-area 8B	3.74E-10	5.59E-10	---	5.59E-10	5.59E-10	0.49	3.5	0.00023	0.00023	0.00023
Sub-area 8C	1.25E-12	2.65E-11	---	---	2.65E-11	0.0052	0.017	---	---	0.017
Area 9	1.29E-11	9.03E-11	---	---	9.03E-11	0.0085	0.031	---	---	0.031

Notes:

Number in bold exceeds the cumulative acceptable target level.

IELCR: Individual excess lifetime cancer risk

HI: Hazard index

NA: Not available

N/A: Not applicable

Table E-3
Summary of Interim Action Remedial Excavations in 2005
Boeing Tract 1, Hazelwood, Missouri

Sub-area	Dimension of Excavated Area	Mass of Soil Excavated (tons)	Samples Excavated/Reference Table		Available Piezometers / Wells
Sub-area 2B	20 ft x 20 ft x 10 ft depth	2073.15 105.1 hazardous waste	B51I1 TP-1 (SB-1) TP-2 (SB-3) SB-4 TP-5 (SB-11) MW-7S (SB-14) SB-18	Table 3B-5(a) Table 3B-5(c) Table 3B-7(a) Table 3B-7(b) Table 3B-7(c)	MW-5I MW-6S MW-10S MW-11D MW-11I MW-11S TP-6 MW-8I MW-8S MW-9S
Sub-area 3A	11.5 ft x 9.5 ft x 8 ft depth	88.23	B42N5	Table 4A-5(a) Table 4A-5(b) Table 4A-5(c) Table 4A-7(a) Table 4A-7(b) Table 4A-7(c)	B42N6 B41MW-18
Sub-area 3E	7 ft x 8 ft x 4 ft depth	8.12	B2E2	Table 4E-7(a) Table 4E-7(b) Table 4E-7(c)	B2E3 B2E5
Sub-area 6B	15 ft x 15 ft x 6 ft depth	56.35	RC2 RC9	Table 7B-7(a) Table 7B-7(b) Table 7B-7(c) Table 7B-7(d) Table 7B-7(e)	RC14 MW3 MW7 MW9S B27W3D B28MW3 B28MW4
Sub-area 8B	10 ft x 10 ft x 5 ft depth	23.02	B220N1	Table 9B-8(b)	B220N4 B220N6 MW4

References:

Mactec, May 2006. Interim Action Remedial Excavation Completion Report, Boeing Tract 1, McDonnell Douglas, Hazelwood, Missouri.

Mactec, June 2006. Interim Measure Completion Report, Solid Waste Management Unit 17, McDonnell Douglas, Hazelwood, Missouri.

Table 3A-12(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 2A: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Benzene	443	1.62E-08	3.08E-04	220	1.95E-08	3.70E-04	3.58E-08	6.77E-04
Dichlorodifluoromethane	3.4	NA	5.11E-06	---	---	---	NA	5.11E-06
Ethylbenzene	376	NA	1.60E-06	---	---	---	NA	1.60E-06
Methylene chloride	2.9	1.80E-11	3.57E-08	---	---	---	1.80E-11	3.57E-08
Tetrachloroethene	10.6	5.00E-10	8.78E-07	---	---	---	5.00E-10	8.78E-07
Toluene	19	NA	3.95E-08	---	---	---	NA	3.95E-08
Xylenes, total	39	NA	1.29E-06	---	---	---	NA	1.29E-06
Organics Total Risk		1.68E-08	3.17E-04		1.95E-08	3.70E-04	3.63E-08	6.86E-04
TPH-GRO	12,428	NA	1.27E-04	70,830	NA	4.70E-02	NA	4.71E-02
TPH-DRO	118,086	NA	1.19E-04	22,344	NA	4.29E-03	NA	4.41E-03
TPH-ORO	2,500	NA	6.40E-08	6.6	NA	2.65E-06	NA	2.71E-06
TPH Total Risk		NA	2.47E-04		NA	5.12E-02	NA	5.15E-02
Arsenic	38,875	NA	NA	47	NA	NA	NA	NA
Cadmium	730	NA	NA	8.9	NA	NA	NA	NA
Mercury	49	NA	1.37E-04	---	---	---	NA	1.37E-04
Antimony	3,785	NA	NA	---	---	---	NA	NA
Beryllium	1,106	NA	NA	---	---	---	NA	NA
Cobalt	6,125	NA	NA	---	---	---	NA	NA
Copper	33,525	NA	NA	---	---	---	NA	NA
Nickel	15,750	NA	NA	---	---	---	NA	NA
Zinc	86,675	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	1.37E-04		NA	NA	NA	1.37E-04
CUMULATIVE RISK		1.68E-08	7.01E-04		1.95E-08	5.16E-02	3.63E-08	5.23E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 3B-12(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 2B: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,1-Dichloroethene	---	---	---	150	5.95E-07	5.95E-02	5.95E-07	5.95E-02
1,2,3-Trimethylbenzene	---	---	---	48	NA	1.91E-04	NA	1.91E-04
1,2,4-Trimethylbenzene	---	---	---	182	NA	1.41E-03	NA	1.41E-03
Acetone	3,885	NA	4.39E-06	---	---	---	NA	4.39E-06
Benzene	---	---	---	239	2.12E-08	7.08E-04	2.12E-08	7.08E-04
Chloroethane	36	1.54E-09	5.13E-07	---	---	---	1.54E-09	5.13E-07
cis-1,2-Dichloroethene	283	NA	1.64E-04	4,497	NA	4.26E-03	NA	4.42E-03
Ethylbenzene	50	NA	2.13E-07	---	---	---	NA	2.13E-07
Isopropyl benzene	1,141	NA	1.11E-04	---	---	---	NA	1.11E-04
Methyl ethyl ketone (MEK)	1,638	NA	7.15E-07	---	---	---	NA	7.15E-07
Methylene chloride	505	3.13E-09	4.65E-05	---	---	---	3.13E-09	4.65E-05
Methyl tert-butyl ether (MTBE)	---	---	---	222	1.24E-10	4.76E-06	1.24E-10	4.76E-06
Naphthalene	11,032	NA	1.48E-04	321	NA	3.95E-04	NA	5.43E-04
n-Butylbenzene	2,168	NA	1.46E-05	221	NA	1.48E-04	NA	1.63E-04
n-Propylbenzene	1,811	NA	3.66E-05	189	NA	1.03E-04	NA	1.39E-04
p-Isopropyltoluene	442	NA	3.36E-07	---	---	---	NA	3.36E-07
sec-Butylbenzene	2,093	NA	2.56E-05	207	NA	1.94E-04	NA	2.20E-04
Tetrachloroethene	16,500	7.77E-07	1.37E-03	19,115	5.06E-06	7.37E-02	5.84E-06	7.51E-02
Toluene	505	NA	1.05E-06	649	NA	9.32E-06	NA	1.04E-05
trans-1,2-Dichloroethene	82	NA	3.59E-05	150	NA	1.43E-04	NA	1.79E-04
Trichloroethene	128	1.19E-09	4.67E-06	1,991	1.15E-07	9.58E-04	1.16E-07	9.62E-04
Vinyl chloride	245	2.22E-07	7.27E-04	728	5.55E-07	5.55E-01	7.77E-07	5.56E-01
Xylenes, Total	352	NA	1.16E-05	---	---	---	NA	1.16E-05
Organics Total Risk		1.00E-06	2.70E-03		6.35E-06	6.97E-01	7.35E-06	7.00E-01
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	4.66E+03	NA	2.72E-03	NA	2.72E-03
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	4.30E+02	NA	7.39E-03	NA	7.39E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	2.73E+03	NA	1.53E-03	NA	1.53E-03
TPH-GRO	58,214	NA	5.96E-04	7.82E+03	NA	1.16E-02	NA	1.22E-02
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	8.77E-04	NA	8.77E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	8.49E-05	NA	8.49E-05
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	2.63E-06	NA	2.63E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	8.11E+03	NA	1.47E-03	NA	1.47E-03
Aromatics > nC12 to nC16 (TX1006)	---	---	---	5.80E+03	NA	4.38E-04	NA	4.38E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	6.50E+02	NA	1.37E-05	NA	1.37E-05
TPH-DRO	817,829	NA	8.26E-04	1.46E+04	NA	2.88E-03	NA	3.71E-03
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	2.63E-06	NA	2.63E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.61E-08	NA	1.61E-08
TPH-ORO	40,250	NA	1.03E-06	6.60E+00	NA	2.65E-06	NA	3.68E-06
TPH Total Risk		NA	1.42E-03		NA	1.45E-02	NA	1.60E-02
Arsenic	11,546	NA	NA	67	NA	NA	NA	NA
Cadmium	1,638	NA	NA	4.0	NA	NA	NA	NA
Chromium	25,878	NA	NA	---	---	---	NA	NA
Mercury	114	NA	3.22E-04	---	---	---	NA	3.22E-04
Selenium	1,003	NA	NA	---	---	---	NA	NA
Silver	1,289	NA	NA	---	---	---	NA	NA
Antimony	2,513	NA	NA	---	---	---	NA	NA
Beryllium	849	NA	NA	---	---	---	NA	NA
Cobalt	6,613	NA	NA	---	---	---	NA	NA
Copper	11,748	NA	NA	---	---	---	NA	NA
Manganese	844,250	NA	NA	---	---	---	NA	NA
Nickel	17,715	NA	NA	---	---	---	NA	NA
Thallium	2,039	NA	NA	---	---	---	NA	NA
Zinc	36,425	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	3.22E-04		NA	NA	NA	3.22E-04
CUMULATIVE RISK		1.00E-06	4.44E-03		6.35E-06	7.12E-01	7.35E-06	7.16E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 3C-12(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 2C: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Benzene	---	---	---	203	1.21E-08	4.04E-04	1.21E-08	4.04E-04
Organics Total Risk		NA	NA		1.21E-08	4.04E-04	1.21E-08	4.04E-04
TPH-GRO	13,000	NA	1.33E-04	73,658	NA	5.20E-01	NA	5.20E-01
TPH-DRO	1,330,000	NA	1.34E-03	513	NA	1.18E-01	NA	1.19E-01
TPH-ORO	34,000	NA	8.69E-07	429	NA	2.61E-01	NA	3.12E-01
TPH Total Risk		NA	1.48E-03		NA	8.99E-01	NA	9.52E-01
CUMULATIVE RISK		NA	1.48E-03		1.21E-08	8.99E-01	1.21E-08	9.52E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 4A-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3A: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,2,4-Trimethylbenzene	26	NA	1.47E-06	7.8	NA	6.86E-05	NA	7.01E-05
1,3,5-Trimethylbenzene	73	NA	2.62E-05	---	---	---	NA	2.62E-05
Benzene	15	5.48E-10	1.04E-05	69	6.92E-09	2.31E-04	7.47E-09	2.41E-04
cis-1,2-Dichloroethene	---	---	---	381	NA	3.97E-04	NA	3.97E-04
Ethylbenzene	12.7	NA	5.40E-08	---	---	---	NA	5.40E-08
Isopropylbenzene	19	NA	1.84E-06	---	---	---	NA	1.84E-06
m,p-Xylene	15	NA	2.42E-07	---	---	---	NA	2.42E-07
Methylene chloride	44.3	2.75E-10	4.09E-06	---	---	---	2.75E-10	4.09E-06
n-Propylbenzene	---	---	---	71	NA	4.47E-05	NA	4.47E-05
p-Isopropyltoluene	63	NA	4.79E-08	---	---	---	NA	4.79E-08
Toluene	51	NA	1.07E-07	---	---	---	NA	1.07E-07
Vinyl chloride	---	---	---	7.3	6.68E-09	6.68E-03	6.68E-09	6.68E-03
Xylenes, Total	40.9	NA	1.35E-06	---	---	---	NA	1.35E-06
Organics Total Risk		8.23E-10	4.58E-05		1.36E-08	7.43E-03	1.44E-08	7.47E-03
TPH-GRO	---	---	---	1,060	NA	7.83E-03	NA	7.83E-03
TPH-DRO	24,000	NA	1.54E-05	3,012	NA	1.51E-03	NA	1.52E-03
TPH-ORO	4,500	NA	1.15E-07	6.6	NA	3.20E-06	NA	3.32E-06
TPH Total Risk		NA	1.56E-05		NA	9.35E-03	NA	9.36E-03
Arsenic	---	---	---	100	NA	NA	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		8.23E-10	6.13E-05		1.36E-08	1.68E-02	1.44E-08	1.68E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4B-10(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3B: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Acetone	19	NA	2.15E-08	---	---	---	NA	2.15E-08
Benzene	55	2.01E-09	3.81E-05	---	---	---	2.01E-09	3.81E-05
Carbon disulfide	3.0	NA	6.85E-07	---	---	---	NA	6.85E-07
Ethylbenzene	14	NA	6.07E-08	---	---	---	NA	6.07E-08
Isopropylbenzene	4.0	NA	3.90E-07	---	---	---	NA	3.90E-07
n-Propylbenzene	2.9	NA	5.88E-08	6.1	NA	3.84E-06	NA	3.90E-06
sec-Butylbenzene	5.7	NA	6.99E-08	---	---	---	NA	6.99E-08
Toluene	5.6	NA	1.16E-08	---	---	---	NA	1.16E-08
Xylenes, Total	58	NA	1.91E-06	---	---	---	NA	1.91E-06
Organics Total Risk		2.01E-09	4.13E-05		NA	3.84E-06	2.01E-09	4.51E-05
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	2,219	NA	1.57E-03	NA	1.57E-03
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	555	NA	1.15E-02	NA	1.15E-02
Aromatics > nC8 to nC10 (TX1006)	---	---	---	555	NA	3.63E-04	NA	3.63E-04
TPH-GRO	29,200	NA	2.99E-04	3,328	NA	1.35E-02	NA	1.38E-02
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	88	NA	2.75E-03	NA	2.75E-03
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	88	NA	1.19E-02	NA	1.19E-02
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	88	NA	1.12E-01	NA	1.12E-01
Aromatics > nC10 to nC12 (TX1006)	---	---	---	88	NA	1.78E-05	NA	1.78E-05
Aromatics > nC12 to nC16 (TX1006)	---	---	---	88	NA	7.08E-06	NA	7.08E-06
Aromatics > nC16 to nC21 (TX1006)	---	---	---	88	NA	1.89E-06	NA	1.89E-06
TPH-DRO	2,081	NA	2.11E-06	529	NA	1.27E-01	NA	1.27E-01
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	136	NA	1.73E-01	NA	1.73E-01
Aromatics > nC21 to nC35 (TX1006)	---	---	---	136	NA	3.31E-07	NA	3.31E-07
TPH-ORO	3,121	NA	7.99E-08	271	NA	1.73E-01	NA	1.73E-01
TPH Total Risk		NA	3.02E-04		NA	3.13E-01	NA	3.13E-01
CUMULATIVE RISK		2.01E-09	3.43E-04		NA	3.13E-01	2.01E-09	3.14E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4C-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3C: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Benzene	---	---	---	120	1.20E-08	4.01E-04	1.20E-08	4.01E-04
Methyl tert-butyl ether	---	---	---	35	2.00E-11	7.68E-07	2.00E-11	7.68E-07
n-Butylbenzene	---	---	---	208	NA	1.63E-04	NA	1.63E-04
n-Propylbenzene	---	---	---	223	NA	1.40E-04	NA	1.40E-04
sec-Butylbenzene	---	---	---	172	NA	1.91E-04	NA	1.91E-04
Organics Total Risk		NA	NA		1.20E-08	8.95E-04	1.20E-08	8.95E-04
TPH-GRO	---	---	---	24,847	NA	2.52E-02	NA	2.52E-02
TPH-DRO	---	---	---	31,485	NA	6.68E-03	NA	6.68E-03
TPH-ORO	---	---	---	6.6	NA	3.20E-06	NA	3.20E-06
TPH Total Risk		NA	NA		NA	3.19E-02	NA	3.19E-02
CUMULATIVE RISK		NA	NA		1.20E-08	3.28E-02	1.20E-08	3.28E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4D-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3D: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,1-Dichloroethene	---	---	---	2.6	8.83E-09	8.83E-04	8.83E-09	8.83E-04
1,2,4-Trimethylbenzene	15,668	NA	3.20E-05	---	---	---	NA	3.20E-05
1,3,5-Trimethylbenzene	18	NA	2.38E-07	---	---	---	NA	2.38E-07
Benzene	11	1.44E-11	2.72E-07	2.1	1.46E-10	4.86E-06	1.60E-10	5.13E-06
Chloroethane	3.6	5.61E-12	1.87E-09	---	---	---	5.61E-12	1.87E-09
Isopropylbenzene	16	NA	5.59E-08	---	---	---	NA	5.59E-08
m,p-Xylene	21	NA	1.24E-08	---	---	---	NA	1.24E-08
n-Butylbenzene	7.3	NA	1.25E-08	---	---	---	NA	1.25E-08
n-Propylbenzene	15	NA	1.12E-08	---	---	---	NA	1.12E-08
o-Xylene	6.3	NA	4.00E-11	---	---	---	NA	4.00E-11
p-Isopropyltoluene	18	NA	5.06E-10	---	---	---	NA	5.06E-10
sec-Butylbenzene	64	NA	2.84E-08	---	---	---	NA	2.84E-08
tert-Butylbenzene	18	NA	5.35E-09	---	---	---	NA	5.35E-09
Tetrachloroethene	5.3	9.09E-12	1.60E-08	6.2	1.37E-09	2.00E-05	1.38E-09	2.00E-05
Trichloroethene	---	---	---	3.3	1.56E-10	1.30E-06	1.56E-10	1.30E-06
Vinyl chloride	---	---	---	2.9	1.99E-09	1.99E-03	1.99E-09	1.99E-03
Xylenes, Total	12	NA	1.44E-08	---	---	---	NA	1.44E-08
Organics Total Risk		2.91E-11	3.26E-05		1.25E-08	2.90E-03	1.25E-08	2.93E-03
TPH-GRO	500	NA	1.86E-07	500	NA	2.72E-03	NA	2.72E-03
TPH-DRO	24,770	NA	9.12E-07	190	NA	3.36E-02	NA	3.36E-02
TPH-ORO	5,610	NA	5.22E-09	75	NA	3.52E-02	NA	3.52E-02
TPH Total Risk		NA	1.10E-06		NA	7.16E-02	NA	7.16E-02
Arsenic	9,700	NA	NA	25	NA	NA	NA	NA
Barium	---	---	---	1,978	NA	NA	NA	NA
Beryllium	470	NA	NA	---	---	---	NA	NA
Cadmium	412	NA	NA	8.2	NA	NA	NA	NA
Chromium	---	---	---	67	NA	NA	NA	NA
Copper	13,317	NA	NA	---	---	---	NA	NA
Manganese	---	---	---	2,156	NA	NA	NA	NA
Nickel	12,247	NA	NA	---	---	---	NA	NA
Selenium	2,336	NA	NA	---	---	---	NA	NA
Thallium	5,967	NA	NA	---	---	---	NA	NA
Zinc	39,892	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		2.91E-11	3.37E-05		1.25E-08	7.45E-02	1.25E-08	7.45E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4E-10(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3E: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,2,4-Trimethylbenzene	---	---	---	2,500	NA	1.93E-02	NA	1.93E-02
Acetone	68	NA	7.66E-08	540	NA	1.43E-07	NA	2.19E-07
Benzene	202	7.39E-09	1.40E-04	---	---	---	7.39E-09	1.40E-04
Ethylbenzene	725	NA	3.07E-06	1,245	NA	7.12E-05	NA	7.42E-05
Isopropylbenzene	140	NA	1.36E-05	---	---	---	NA	1.36E-05
Methyl tert-butyl ether	39	3.05E-11	1.09E-07	---	---	---	3.05E-11	1.09E-07
Methylene chloride	10	6.19E-11	1.23E-07	---	---	---	6.19E-11	1.23E-07
m,p-Xylene	---	---	---	5,300	NA	6.41E-04	NA	6.41E-04
Naphthalene	206	NA	2.75E-06	930	NA	1.14E-03	NA	1.14E-03
n-Butylbenzene	131	NA	8.82E-07	---	---	---	NA	8.82E-07
n-Propylbenzene	453	NA	9.15E-06	380	NA	2.05E-04	NA	2.15E-04
sec-Butylbenzene	52	NA	6.35E-07	---	---	---	NA	6.35E-07
Toluene	115	NA	2.38E-07	---	---	---	NA	2.38E-07
Xylenes, total	1533	NA	5.04E-05	---	---	---	NA	5.04E-05
Organics Total Risk		7.48E-09	2.21E-04		NA	2.14E-02	7.48E-09	2.16E-02
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	4.92E+03	NA	2.87E-03	NA	2.87E-03
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	4.30E+02	NA	7.37E-03	NA	7.37E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	1.97E+04	NA	1.10E-02	NA	1.10E-02
TPH-GRO	180,057	NA	1.84E-03	2.50E+04	NA	2.12E-02	NA	2.31E-02
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	8.74E-04	NA	8.74E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	8.47E-05	NA	8.47E-05
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	2.62E-06	NA	2.62E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	8.34E+03	NA	1.51E-03	NA	1.51E-03
Aromatics > nC12 to nC16 (TX1006)	---	---	---	5.80E+03	NA	4.37E-04	NA	4.37E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	6.50E+02	NA	1.36E-05	NA	1.36E-05
TPH-DRO	5,304	NA	5.35E-06	1.48E+04	NA	2.92E-03	NA	2.92E-03
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	2.62E-06	NA	2.62E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.60E-08	NA	1.60E-08
TPH-ORO	5,455	NA	1.39E-07	6.60E+00	NA	2.64E-06	NA	2.78E-06
TPH Total Risk		NA	1.84E-03		NA	2.41E-02	NA	2.60E-02
CUMULATIVE RISK		7.48E-09	2.06E-03		NA	4.55E-02	7.48E-09	4.76E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4F-10(a)

**Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3F: Retained Area, Boeing Tract 1, St. Louis, Missouri**

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
TPH-GRO	---	---	---	500	NA	2.86E-03	NA	2.86E-03
TPH-DRO	---	---	---	514	NA	9.57E-02	NA	9.57E-02
TPH-ORO	---	---	---	1,543	NA	7.62E-01	NA	7.62E-01
TPH Total Risk		NA	NA		NA	8.61E-01	NA	8.61E-01
CUMULATIVE RISK		NA	NA		NA	8.61E-01	NA	8.61E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4G-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3G: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,2,4-Trimethylbenzene	840	NA	2.72E-06	5.5	NA	3.55E-05	NA	3.82E-05
1,3,5-Trimethylbenzene	326	NA	6.74E-06	---	---	---	NA	6.74E-06
Acetone	820	NA	5.35E-08	---	---	---	NA	5.35E-08
Benzene	548	1.16E-09	2.20E-05	484	3.49E-08	1.16E-03	3.61E-08	1.19E-03
Ethylbenzene	1,010	NA	2.48E-07	---	---	---	NA	2.48E-07
m,p-Xylene	2,650	NA	2.51E-06	---	---	---	NA	2.51E-06
Methyl tert-butyl ether	378	1.71E-11	6.11E-08	---	---	---	1.71E-11	6.11E-08
Naphthalene	478	NA	3.69E-07	---	---	---	NA	3.69E-07
o-Xylene	1,490	NA	1.51E-08	---	---	---	NA	1.51E-08
p-Isopropyltoluene	416	NA	1.83E-08	---	---	---	NA	1.83E-08
Toluene	5,700	NA	6.84E-07	---	---	---	NA	6.84E-07
Xylenes, Total	3,550	NA	6.75E-06	---	---	---	NA	6.75E-06
Organics Total Risk		1.18E-09	4.21E-05		3.49E-08	1.20E-03	3.61E-08	1.24E-03
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	1.68E+03	NA	9.22E-04	NA	9.22E-04
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	4.30E+02	NA	6.94E-03	NA	6.94E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	1.68E+03	NA	8.17E-04	NA	8.17E-04
TPH-GRO	3,280	NA	1.94E-06	3.79E+03	NA	8.68E-03	NA	8.68E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	8.23E-04	NA	8.23E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	7.97E-05	NA	7.97E-05
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	2.47E-06	NA	2.47E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	2.22E+02	NA	3.17E-05	NA	3.17E-05
Aromatics > nC12 to nC16 (TX1006)	---	---	---	2.22E+02	NA	1.21E-05	NA	1.21E-05
Aromatics > nC16 to nC21 (TX1006)	---	---	---	2.22E+02	NA	3.12E-06	NA	3.12E-06
TPH-DRO	85,750	NA	5.00E-06	7.01E+02	NA	9.52E-04	NA	9.57E-04
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	2.47E-06	NA	2.47E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.04E-08	NA	1.04E-08
TPH-ORO	1,470,000	NA	2.17E-06	6.60E+00	NA	2.48E-06	NA	4.65E-06
TPH Total Risk		NA	9.11E-06		NA	9.63E-03	NA	9.64E-03
CUMULATIVE RISK		NA	5.12E-05		3.49E-08	1.08E-02	3.61E-08	1.09E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4H-10(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 3H: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
TPH-GRO	---	---	---	275	NA	6.42E-04	NA	6.42E-04
TPH-DRO	---	---	---	2,520	NA	5.74E-01	NA	5.74E-01
TPH-ORO	---	---	---	213	NA	1.29E-01	NA	1.29E-01
TPH Total Risk		NA	NA		NA	7.04E-01	NA	7.04E-01
Arsenic	---	---	---	80	NA	NA	NA	NA
Manganese	---	---	---	8,860	NA	NA	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		NA	NA		NA	7.04E-01	NA	7.04E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 5-9(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Area 4: Power Plant, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Acetone	23	NA	1.40E-09	---	---	---	NA	1.40E-09
Methyl ethyl ketone (MEK)	5.1	NA	1.19E-10	---	---	---	NA	1.19E-10
Methylene chloride	2.7	8.90E-13	1.32E-08	---	---	---	8.90E-13	1.32E-08
Toluene	2.8	NA	3.15E-10	---	---	---	NA	3.15E-10
Anthracene	3.0	NA	3.49E-13	---	---	---	NA	3.49E-13
Benzo(a)anthracene	5.1	1.46E-16	NA	5.5	3.99E-11	7.98E-06	3.99E-11	7.98E-06
Benzo(a)pyrene	7.5	7.95E-16	NA	---	---	---	7.95E-16	NA
Benzo(b)fluoranthene	28	4.61E-16	NA	5.4	6.74E-11	1.35E-05	6.74E-11	1.35E-05
Benzo(g,h,i)perylene	13	NA	1.44E-13	---	---	---	NA	1.44E-13
Benzo(k)fluoranthene	2.8	1.58E-17	NA	---	---	---	1.58E-17	NA
Chrysene	7.1	3.78E-17	NA	---	---	---	3.78E-17	NA
Dibenzo(a,h)anthracene	35	6.67E-16	NA	---	---	---	6.67E-16	NA
Fluoranthene	11	NA	1.93E-13	---	---	---	NA	1.93E-13
Indeno(1,2,3-cd)pyrene	5.9	1.15E-17	NA	---	---	---	1.15E-17	NA
Phenanthrene	24	NA	1.43E-11	---	---	---	NA	1.43E-11
Pyrene	21	NA	5.04E-13	---	---	---	NA	5.04E-13
Carbazole	---	---	---	6.4	1.78E-12	1.78E-07	1.78E-12	1.78E-07
Organics Total Risk		8.92E-13	1.51E-08		1.09E-10	2.16E-05	1.10E-10	2.17E-05
TPH-GRO	---	---	---	388	NA	2.41E-03	NA	2.41E-03
TPH-DRO	---	---	---	1,683	NA	3.40E-01	NA	3.40E-01
TPH-ORO	---	---	---	238	NA	1.28E-01	NA	1.28E-01
TPH Total Risk		NA	NA		NA	4.70E-01	NA	4.70E-01
Arsenic	7,508	NA	NA	48	NA	NA	NA	NA
Manganese	---	---	---	4,864	NA	NA	NA	NA
Selenium	1,262	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		8.92E-13	1.51E-08		1.09E-10	4.70E-01	1.10E-10	4.70E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 6-8(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Area 5: IWTP, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
TPH-GRO	93,000	NA	2.83E-04	---	---	---	NA	2.83E-04
TPH-DRO	200,000	NA	6.07E-05	---	---	---	NA	6.07E-05
TPH Total Risk		NA	3.44E-04		NA	NA	NA	3.44E-04
Arsenic	8,226	NA	NA	---	---	---	NA	NA
Chromium	---	---	---	170	NA	NA	NA	NA
Cyanide, total	241	NA	NA	---	---	---	NA	NA
Mercury	65	NA	1.83E-04	---	---	---	NA	1.83E-04
Nickel	15,500	NA	NA	---	---	---	NA	NA
Selenium	1,201	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	1.83E-04		NA	NA	NA	1.83E-04
CUMULATIVE RISK		NA	5.27E-04		NA	NA	NA	5.27E-04

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 7A-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker

Sub-area 6A: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Benzene	---	---	---	0.76	6.73E-11	1.27E-06	6.73E-11	1.27E-06
Organics Total Risk		NA	NA		6.73E-11	1.27E-06	6.73E-11	1.27E-06
TPH-GRO	---	---	---	730	NA	4.46E-03	NA	4.46E-03
TPH-DRO	---	---	---	250	NA	4.95E-02	NA	4.95E-02
TPH Total Risk		NA	NA		NA	5.40E-02	NA	5.40E-02
Arsenic	---	---	---	102	NA	NA	NA	NA
Barium	---	---	---	11,567	NA	NA	NA	NA
Cadmium	---	---	---	7.5	NA	NA	NA	NA
Chromium	---	---	---	539	NA	NA	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		NA	NA		6.73E-11	5.40E-02	6.73E-11	5.40E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 7B-10(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 6B: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
1,1-Dichloroethene	---	---	---	8.0	3.64E-08	1.02E-05	3.64E-08	1.02E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	---	---	---	640	NA	3.34E-05	NA	3.34E-05
1,2,3-Trimethylbenzene	---	---	---	0.7	NA	3.16E-06	NA	3.16E-06
1,2,4-Trimethylbenzene	---	---	---	3.4	NA	2.91E-05	NA	2.91E-05
Acetone	67	NA	7.52E-08	---	---	---	NA	7.52E-08
Benzene	---	---	---	13	1.31E-09	2.47E-05	1.31E-09	2.47E-05
Bromomethane	---	---	---	14	NA	1.51E-04	NA	1.51E-04
cis-1,2-Dichloroethene	1	NA	4.77E-07	582	NA	5.97E-04	NA	5.98E-04
Dichlorodifluoromethane	---	---	---	35	NA	1.47E-04	NA	1.47E-04
Ethylbenzene	3.2	NA	1.36E-08	---	---	---	NA	1.36E-08
Methylene chloride	---	---	---	13	5.73E-11	8.51E-07	5.73E-11	8.51E-07
Methyl tert-butyl ether (MTBE)	---	---	---	32	1.80E-11	6.43E-08	1.80E-11	6.43E-08
Tetrachloroethene	8	3.61E-10	6.34E-07	20	5.93E-09	1.04E-05	6.29E-09	1.11E-05
Toluene	9	NA	1.93E-08	---	---	---	NA	1.93E-08
trans-1,2-Dichlorobenzene	36	NA	1.04E-07	---	---	---	NA	1.04E-07
trans-1,2-Dichloroethene	---	---	---	58	NA	6.17E-05	NA	6.17E-05
Trichloroethene	15	1.43E-10	5.59E-07	112	7.29E-09	2.85E-05	7.43E-09	2.91E-05
Vinyl chloride	10.3	9.35E-09	3.06E-05	149	1.33E-07	4.34E-04	1.42E-07	4.65E-04
Xylenes, total	10	NA	3.27E-07	---	---	---	NA	3.27E-07
Aroclor 1254	---	---	---	296	NA	NA	NA	NA
Acenaphthene	1,096	NA	1.62E-08	---	---	---	NA	1.62E-08
Acenaphthylene	40	NA	4.88E-10	---	---	---	NA	4.88E-10
Benzo(a)anthracene	126	6.71E-14	NA	126	1.28E-09	NA	1.28E-09	NA
Benzo(b)fluoranthene	126	3.80E-14	NA	---	---	---	3.80E-14	NA
Chrysene	173	1.70E-14	NA	---	---	---	1.70E-14	NA
Fluoranthene	185	NA	6.17E-11	---	---	---	NA	6.17E-11
Fluorene	133	NA	7.42E-10	---	---	---	NA	7.42E-10
Pyrene	171	NA	7.78E-11	---	---	---	NA	7.78E-11
Organics Total Risk		9.85E-09	3.28E-05		1.85E-07	1.53E-03	1.95E-07	1.56E-03
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	8.85E+02	NA	6.06E-04	NA	6.06E-04
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	5.53E+01	NA	1.11E-03	NA	1.11E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	5.53E+01	NA	3.52E-05	NA	3.52E-05
TPH-GRO	478	NA	4.90E-06	9.96E+02	NA	1.75E-03	NA	1.76E-03

Table 7B-10(a)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 6B: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	1.03E-03	NA	1.03E-03
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	9.94E-05	NA	9.94E-05
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	3.08E-06	NA	3.08E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	5.58E+03	NA	1.10E-03	NA	1.10E-03
Aromatics > nC12 to nC16 (TX1006)	---	---	---	5.58E+03	NA	4.43E-04	NA	4.43E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	6.50E+02	NA	1.39E-05	NA	1.39E-05
TPH-DRO	47,583	NA	4.82E-05	1.18E+04	NA	2.69E-03	NA	2.74E-03
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	3.08E-06	NA	3.08E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.61E-08	NA	1.61E-08
TPH-ORO	---	---	---	6.60E+00	NA	3.10E-06	NA	3.10E-06
TPH Total Risk		NA	5.31E-05		NA	4.45E-03	NA	4.50E-03
Arsenic	27,807	NA	NA	108	NA	NA	NA	NA
Barium	---	---	---	5,440	NA	NA	NA	NA
Cadmium	583	NA	NA	1,177	NA	NA	NA	NA
Chromium	---	---	---	412	NA	NA	NA	NA
Mercury	34	NA	9.69E-05	1.2	NA	1.53E-04	NA	2.50E-04
Selenium	1,687	NA	NA	---	---	---	NA	NA
Antimony	3,964	NA	NA	---	---	---	NA	NA
Beryllium	937	NA	NA	---	---	---	NA	NA
Cobalt	8,404	NA	NA	---	---	---	NA	NA
Copper	19,350	NA	NA	---	---	---	NA	NA
Manganese	1,084,100	NA	NA	6,400	NA	NA	NA	NA
Nickel	28,150	NA	NA	---	---	---	NA	NA
Zinc	52,140	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	9.69E-05		NA	1.53E-04	NA	2.50E-04
CUMULATIVE RISK		9.85E-09	1.83E-04		1.85E-07	6.13E-03	1.95E-07	6.31E-03

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 7C-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker

Sub-area 6C: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
2-Hexanone (MBK)	---	---	---	4.3	NA	9.83E-07	NA	9.83E-07
Acetone	55	NA	1.90E-08	---	---	---	NA	1.90E-08
cis-1,2-Dichloroethene	2.5	NA	4.48E-07	96	NA	1.05E-04	NA	1.05E-04
Dichlorodifluoromethane	3.6	NA	1.67E-06	---	---	---	NA	1.67E-06
Ethylbenzene	540	NA	7.08E-07	---	---	---	NA	7.08E-07
Methyl ethyl ketone (MEK)	13	NA	1.76E-09	---	---	---	NA	1.76E-09
Methyl isobutyl ketone	11	NA	2.74E-10	---	---	---	NA	2.74E-10
o-Xylene	600	NA	3.25E-08	---	---	---	NA	3.25E-08
Trichloroethene	4.2	1.21E-11	4.75E-08	240	1.77E-08	6.94E-05	1.77E-08	6.94E-05
Vinyl chloride	---	---	---	5.2	5.55E-09	1.82E-05	5.55E-09	1.82E-05
Xylenes, total	206	NA	2.10E-06	---	---	---	NA	2.10E-06
Chrysene	406	1.23E-14	NA	---	---	---	1.23E-14	NA
Organics Total Risk		1.21E-11	5.02E-06		2.33E-08	1.93E-04	2.33E-08	1.98E-04
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	1.10E+02	NA	9.05E-05	NA	9.05E-05
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	4.65E+01	NA	1.13E-03	NA	1.13E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	4.65E+01	NA	3.40E-05	NA	3.40E-05
TPH-GRO	64,052	NA	2.02E-04	2.03E+02	NA	1.25E-03	NA	1.45E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	1.23E-03	NA	1.23E-03
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	1.20E-04	NA	1.20E-04
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	3.71E-06	NA	3.71E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	1.50E+03	NA	3.20E-04	NA	3.20E-04
Aromatics > nC12 to nC16 (TX1006)	---	---	---	1.95E+03	NA	1.59E-04	NA	1.59E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	6.50E+02	NA	1.37E-05	NA	1.37E-05
TPH-DRO	566,000	NA	1.77E-04	4.13E+03	NA	1.85E-03	NA	2.03E-03

Table 7C-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 6C: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	3.71E-06	NA	3.71E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.56E-08	NA	1.56E-08
TPH-ORO	---	---	---	6.60E+00	NA	3.72E-06	NA	3.72E-06
TPH Total Risk		NA	3.79E-04		NA	3.10E-03	NA	3.48E-03
Arsenic	6,061	NA	NA	81	NA	NA	NA	NA
Barium	---	---	---	2,574	NA	NA	NA	NA
Cadmium	---	---	---	669	NA	NA	NA	NA
Chromium	27,165	NA	NA	2,381	NA	NA	NA	NA
Chromium, hexavalent	---	---	---	16	NA	NA	NA	NA
Mercury	33	NA	2.86E-05	0.76	NA	1.11E-04	NA	1.39E-04
Selenium	342	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	2.86E-05		NA	1.11E-04	NA	1.39E-04
CUMULATIVE RISK		1.21E-11	4.13E-04		2.33E-08	3.41E-03	2.33E-08	3.82E-03

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 7D-10(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 6D: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Dichlorodifluoromethane	5.5	NA	8.16E-06	---	---	---	NA	8.16E-06
Tetrachloroethene	---	---	---	12	3.08E-09	5.41E-06	3.08E-09	5.41E-06
Toluene	39	NA	7.99E-08	---	---	---	NA	7.99E-08
Organics Total Risk		NA	8.24E-06		3.08E-09	5.41E-06	3.08E-09	1.36E-05
TPH-GRO	12,000	NA	1.23E-04	---	---	---	NA	1.23E-04
TPH-DRO	2,500	NA	2.52E-06	---	---	---	NA	2.52E-06
TPH-ORO	2,500	NA	6.38E-08	---	---	---	NA	6.38E-08
TPH Total Risk		NA	1.25E-04		NA	NA	NA	1.25E-04
Arsenic	---	---	---	8.9	NA	NA	NA	NA
Chromium	---	---	---	41	NA	NA	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		NA	1.33E-04		3.08E-09	5.41E-06	3.08E-09	1.39E-04

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 9A-11(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 8A: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Toluene	---	---	---	1.5	NA	2.37E-08	NA	2.37E-08
Trichloroethene	40	3.74E-10	1.46E-06	110	7.28E-09	2.85E-05	7.65E-09	3.00E-05
Vinyl chloride	---	---	---	1.9	1.73E-09	5.67E-06	1.73E-09	5.67E-06
Organics Total Risk		3.74E-10	1.46E-06		9.01E-09	3.42E-05	9.39E-09	3.57E-05
Arsenic	12,500	NA	NA	23	NA	NA	NA	NA
Barium	---	---	---	860	NA	NA	NA	NA
Chromium	---	---	---	110	NA	NA	NA	NA
Manganese	---	---	---	1,300	NA	NA	NA	NA
Mercury	38	NA	1.09E-04	---	---	---	NA	1.09E-04
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		3.74E-10	1.46E-06		9.01E-09	3.42E-05	9.39E-09	3.57E-05

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 9B-11(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Sub-area 8B: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	8.33E+01	NA	4.87E-05	NA	4.87E-05
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	8.33E+01	NA	1.43E-03	NA	1.43E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	8.33E+01	NA	4.67E-05	NA	4.67E-05
TPH-GRO	---	---	---	2.50E+02	NA	1.53E-03	NA	1.53E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	3.40E+01	NA	8.77E-04	NA	8.77E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	7.60E-01	NA	8.49E-05	NA	8.49E-05
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	2.50E-03	NA	2.63E-06	NA	2.63E-06
Aromatics > nC10 to nC12 (TX1006)	---	---	---	4.67E+02	NA	8.46E-05	NA	8.46E-05
Aromatics > nC12 to nC16 (TX1006)	---	---	---	3.74E+03	NA	2.82E-04	NA	2.82E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	6.50E+02	NA	1.37E-05	NA	1.37E-05
TPH-DRO	---	---	---	4.89E+03	NA	1.34E-03	NA	1.34E-03
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	2.50E-03	NA	2.63E-06	NA	2.63E-06
Aromatics > nC21 to nC35 (TX1006)	---	---	---	6.60E+00	NA	1.61E-08	NA	1.61E-08
TPH-ORO	---	---	---	6.60E+00	NA	2.65E-06	NA	2.65E-06
TPH Total Risk		NA	NA		NA	2.88E-03	NA	2.88E-03
Arsenic	---	---	---	15	NA	NA	NA	NA
Chromium	---	---	---	51	NA	NA	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		NA	NA		NA	2.88E-03	NA	2.88E-03

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 9C-11(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
 Sub-area 8C: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
TPH-GRO	---	---	---	650	NA	4.72E-03	NA	4.72E-03
TPH-DRO	---	---	---	250	NA	5.90E-02	NA	5.90E-02
TPH Total Risk		NA	NA		NA	6.38E-02	NA	6.38E-02
CUMULATIVE RISK		NA	NA		NA	6.38E-02	NA	6.38E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 10-8(a)

Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Current On-site Non-residential Worker
Area 9: Gun Range, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Indoor Inhalation of Vapors from Subsurface Soil		Average GW Conc. (ug/L)	Indoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ		IELCR	HQ		
Acetone	20	NA	2.24E-08	---	---	---	NA	2.24E-08
Methylene chloride	2.9	1.79E-11	2.65E-07	---	---	---	1.79E-11	2.65E-07
Naphthalene	2.6	NA	3.46E-11	---	---	---	NA	3.46E-11
Organics Total Risk		1.79E-11	2.88E-07		NA	NA	1.79E-11	2.88E-07
TPH-GRO	---	---	---	500	NA	3.04E-03	NA	3.04E-03
TPH-DRO	---	---	---	121	NA	2.39E-02	NA	2.39E-02
TPH-ORO	---	---	---	311	NA	1.63E-01	NA	1.63E-01
TPH Total Risk		NA	NA		NA	1.90E-01	NA	1.90E-01
Arsenic	---	---	---	37	NA	NA	NA	NA
Cadmium	513	NA	NA	---	---	---	NA	NA
Copper	17,700	NA	NA	---	---	---	NA	NA
Manganese	1,178,000	NA	NA	1,750	NA	NA	NA	NA
Nickel	20,100	NA	NA	---	---	---	NA	NA
Selenium	1,363	NA	NA	---	---	---	NA	NA
Zinc	63,700	NA	NA	---	---	---	NA	NA
Metals Total Risk		NA	NA		NA	NA	NA	NA
CUMULATIVE RISK		1.79E-11	2.88E-07		NA	1.90E-01	1.79E-11	1.90E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum organic

Table 2-9(R)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Area 1: Runway Protection Zone, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,2,3-Trimethylbenzene	---	---	---	---	---	---	---	1.7	NA	NA	NA	2.40E-06	NA	2.40E-06
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	1.2	NA	NA	NA	2.52E-06	NA	2.52E-06
Acetone	25	NA	2.62E-08	NA	9.11E-09	NA	1.49E-07	48.9	NA	NA	NA	7.15E-08	NA	2.55E-07
Benzene	32,196	1.67E-08	8.98E-03	5.58E-09	2.99E-03	1.05E-07	4.96E-02	6.1	2.96E-09	1.59E-03	6.35E-12	3.00E-06	1.30E-07	6.32E-02
Ethylbenzene	32,056	NA	3.35E-04	NA	1.03E-04	NA	6.62E-04	---	---	---	---	---	NA	1.10E-03
n-Propylbenzene	---	---	---	---	---	---	---	4.3	NA	NA	NA	5.71E-07	NA	5.71E-07
Toluene	195,660	NA	2.56E-04	NA	8.53E-04	NA	1.42E-03	---	---	---	---	---	NA	2.53E-03
Xylenes, Total	130,160	NA	6.81E-04	NA	2.30E-04	NA	2.37E-02	---	---	---	---	---	NA	2.46E-02
Organics Total Risk		1.67E-08	1.03E-02	5.58E-09	4.18E-03	1.05E-07	7.54E-02		2.96E-09	1.59E-03	6.35E-12	8.57E-06	1.30E-07	9.14E-02
TPH-GRO	57,836	NA	2.87E-04	NA	2.37E-04	NA	2.26E-03	3,416	NA	NA	NA	4.14E-03	NA	6.92E-03
TPH-DRO	2,500	NA	1.87E-05	NA	1.51E-05	NA	3.18E-05	353	NA	NA	NA	1.38E-02	NA	1.39E-02
TPH-ORO	16,875	NA	2.55E-04	NA	1.96E-04	NA	8.29E-06	1,020	NA	NA	NA	1.93E-05	NA	4.79E-04
TPH Total Risk		NA	5.61E-04	NA	4.48E-04	NA	2.30E-03		NA	NA	NA	1.80E-02	NA	2.13E-02
Antimony	4,005	NA	3.49E-05	NA	3.49E-04	NA	1.34E-05	---	---	---	---	---	NA	3.97E-04
Arsenic	19,018	4.26E-08	6.63E-03	1.49E-07	2.31E-02	1.94E-10	3.02E-06	47.5	NA	NA	NA	NA	1.91E-07	2.97E-02
Beryllium	1,155	4.95E-09	2.01E-05	4.95E-08	2.01E-04	6.60E-12	9.63E-06	---	---	---	---	---	5.44E-08	2.31E-04
Cobalt	9,885	NA	1.72E-03	NA	1.72E-04	6.59E-11	8.26E-05	---	---	---	---	---	6.59E-11	1.98E-03
Copper	14,600	NA	1.27E-05	NA	1.27E-04	NA	2.43E-06	---	---	---	---	---	NA	1.42E-04
Manganese	1,338,750	NA	3.00E-04	NA	3.33E-03	NA	4.55E-03	---	---	---	---	---	NA	8.18E-03
Mercury	121	NA	1.41E-05	NA	1.41E-04	NA	1.33E-03	---	---	---	---	---	NA	1.49E-03
Nickel	23,075	NA	2.01E-06	NA	4.02E-05	1.32E-11	1.92E-05	---	---	---	---	---	1.32E-11	6.15E-05
Selenium	1,518	NA	1.06E-05	NA	8.47E-05	NA	2.53E-05	---	---	---	---	---	NA	1.21E-04
Metals Total Risk		4.76E-08	8.75E-03	1.98E-07	2.76E-02	2.80E-10	6.04E-03		NA	NA	NA	NA	2.46E-07	4.23E-02
CUMULATIVE RISK		6.43E-08	1.96E-02	2.04E-07	3.22E-02	1.05E-07	8.38E-02		2.96E-09	1.59E-03	6.35E-12	1.80E-02	3.76E-07	1.55E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total Petroleum Carbon

GRO: Gasoline Range Organic

DRO: Diesel Range Organic

ORO: Oil Range Organic

ug/kg: microgram per kilogram

ug/L: microgram per liter

Table 3A-12(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 2A: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Benzene	622	3.24E-10	1.74E-04	1.08E-10	5.79E-05	2.20E-09	1.04E-03	220	1.07E-07	5.74E-02	7.50E-11	3.55E-05	1.10E-07	5.87E-02
Dichlorodifluoromethane	3.1	NA	5.41E-08	NA	5.41E-09	NA	2.95E-06	---	---	---	---	---	NA	3.01E-06
Ethylbenzene	570	NA	5.97E-06	NA	1.83E-06	NA	1.28E-05	---	---	---	---	---	NA	2.06E-05
Methylene chloride	3.5	3.96E-13	6.16E-08	1.32E-13	2.05E-08	1.59E-12	5.89E-07	---	---	---	---	---	2.11E-12	6.71E-07
Tetrachloroethene	10	8.47E-12	1.10E-07	2.82E-11	3.65E-07	4.61E-11	2.03E-06	---	---	---	---	---	8.28E-11	2.50E-06
Toluene	67	NA	8.83E-08	NA	2.94E-07	NA	5.34E-07	---	---	---	---	---	NA	9.16E-07
Trichloroethene	1.9	6.14E-16	2.17E-11	1.23E-13	4.34E-09	2.14E-12	2.09E-07	---	---	---	---	---	2.26E-12	2.13E-07
Xylenes, total	30.0	NA	1.57E-07	NA	5.29E-08	NA	5.93E-06	---	---	---	---	---	NA	6.14E-06
Organics Total Risk		3.32E-10	1.80E-04	1.36E-10	6.04E-05	2.25E-09	1.07E-03		1.07E-07	5.74E-02	7.50E-11	3.55E-05	1.10E-07	5.87E-02
TPH-GRO	12,428	NA	NA	NA	5.09E-05	NA	5.27E-04	70,830	NA	NA	NA	3.50E-03	NA	4.07E-03
TPH-DRO	2,228,359	NA	1.47E-02	NA	1.34E-02	NA	3.08E-02	22,344	NA	NA	NA	4.66E-04	NA	5.95E-02
TPH-ORO	2,500	NA	1.91E-05	NA	1.47E-05	NA	3.72E-06	6.6	NA	NA	NA	2.32E-07	NA	3.78E-05
TPH Total Risk		NA	1.48E-02	NA	1.35E-02	NA	3.13E-02		NA	NA	NA	3.96E-03	NA	6.36E-02
Arsenic	38,875	8.72E-08	1.36E-02	3.04E-07	4.72E-02	3.67E-09	5.71E-05	47	NA	NA	NA	NA	3.94E-07	6.08E-02
Cadmium	730	NA	2.55E-06	NA	2.55E-04	2.90E-11	6.44E-07	8.9	NA	NA	NA	NA	2.90E-11	2.58E-04
Mercury	49	NA	5.64E-06	NA	5.67E-05	NA	1.63E-03	---	---	---	---	---	NA	1.69E-03
Antimony	3,785	NA	3.30E-04	NA	3.30E-03	NA	1.17E-04	---	---	---	---	---	NA	3.75E-03
Beryllium	1,106	4.74E-09	1.93E-05	4.74E-08	1.93E-04	5.85E-11	8.54E-05	---	---	---	---	---	5.22E-08	2.97E-04
Cobalt	6,125	NA	1.07E-03	NA	1.07E-04	3.78E-10	4.74E-04	---	---	---	---	---	3.78E-10	1.65E-03
Copper	33,525	NA	2.92E-05	NA	2.92E-04	NA	5.17E-05	---	---	---	---	---	NA	3.73E-04
Nickel	15,750	NA	1.37E-06	NA	2.75E-05	8.33E-11	1.22E-04	---	---	---	---	---	8.33E-11	1.50E-04
Zinc	86,675	NA	1.01E-05	NA	1.01E-04	NA	1.27E-07	---	---	---	---	---	NA	1.11E-04
Metals Total Risk		9.19E-08	1.50E-02	3.51E-07	5.16E-02	4.22E-09	2.54E-03		NA	NA	NA	NA	4.47E-07	6.91E-02
CUMULATIVE RISK		9.22E-08	3.00E-02	3.51E-07	6.51E-02	6.48E-09	3.49E-02		1.07E-07	5.74E-02	7.50E-11	4.00E-03	5.57E-07	1.91E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 3B-12(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 2B: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,1-Dichloroethene	60	5.38E-10	1.39E-06	1.79E-10	4.65E-07	4.67E-09	3.28E-05	150	4.78E-07	1.24E-03	1.68E-09	1.18E-05	4.85E-07	1.29E-03
1,2,3-Trimethylbenzene	---	---	---	---	---	---	---	48	NA	NA	NA	2.24E-05	NA	2.24E-05
1,2,4-Trimethylbenzene	78	NA	1.63E-06	NA	5.00E-07	NA	8.31E-05	182	NA	NA	NA	1.25E-04	NA	2.10E-04
Acetone	1,966	NA	2.06E-06	NA	7.16E-07	NA	1.23E-05	---	---	---	---	---	NA	1.50E-05
Benzene	---	---	---	---	---	---	---	239	1.16E-07	6.23E-02	8.15E-11	3.86E-05	1.16E-07	6.24E-02
Chloroethane	28	4.05E-12	2.44E-07	4.05E-13	2.44E-08	4.37E-11	3.64E-07	---	---	---	---	---	4.82E-11	6.33E-07
cis-1,2-Dichloroethene	3,128	NA	3.27E-05	NA	1.09E-04	NA	4.42E-03	4,497	NA	NA	NA	5.15E-04	NA	5.08E-03
Ethylbenzene	109	NA	1.14E-06	NA	3.85E-07	NA	2.45E-06	---	---	---	---	---	NA	3.97E-06
Isopropyl benzene	561	NA	5.87E-06	NA	1.96E-06	NA	9.79E-05	---	---	---	---	---	NA	1.06E-04
m,p-Xylene	199	NA	3.47E-07	NA	3.47E-08	NA	1.35E-05	---	---	---	---	---	NA	1.39E-05
Methyl ethyl ketone (MEK)	1,131	NA	1.97E-06	NA	6.57E-07	NA	3.67E-06	---	---	---	---	---	NA	6.30E-06
Methylene chloride	275	3.08E-11	4.80E-06	1.03E-11	1.60E-06	1.23E-10	4.58E-05	---	---	---	---	---	1.64E-10	5.22E-05
Methyl tert-butyl ether	---	---	---	---	---	---	---	222	1.10E-09	5.41E-05	1.92E-12	1.72E-07	1.10E-09	5.43E-05
Naphthalene	5,349	NA	1.12E-04	NA	1.12E-04	NA	3.92E-03	321	NA	NA	NA	1.82E-04	NA	4.32E-03
n-Butylbenzene	1,089	NA	9.49E-05	NA	9.49E-06	NA	8.30E-05	221	NA	NA	NA	1.14E-05	NA	1.99E-04
n-Propylbenzene	884	NA	2.77E-05	NA	9.25E-06	NA	1.17E-04	189	NA	NA	NA	8.19E-06	NA	1.62E-04
o-Xylene	70	NA	1.22E-07	NA	1.22E-08	NA	4.93E-07	---	---	---	---	---	NA	6.27E-07
p-Isopropyltoluene	266	NA	2.78E-06	NA	2.78E-07	NA	2.55E-06	---	---	---	---	---	NA	5.61E-06
sec-Butylbenzene	1,044	NA	9.10E-05	NA	9.10E-06	NA	1.07E-04	207	NA	NA	NA	1.42E-05	NA	2.21E-04
Tetrachloroethene	200,066	1.62E-07	2.09E-03	5.39E-07	6.98E-03	8.80E-07	3.87E-02	19,115	3.30E-04	4.27E+00	1.50E-08	6.58E-04	3.31E-04	4.31E+00
Toluene	352	NA	4.60E-07	NA	1.53E-06	NA	2.78E-06	649	NA	1.70E-02	NA	8.18E-07	NA	1.70E-02
trans-1,2-Dichloroethene	420	NA	2.20E-06	NA	7.32E-06	NA	3.65E-04	150	NA	NA	NA	1.33E-05	NA	3.87E-04
Trichloroethene	498	1.64E-13	5.79E-09	3.27E-11	1.16E-06	5.70E-10	5.58E-05	1,991	2.79E-07	9.87E-03	3.76E-10	3.68E-05	2.80E-07	9.97E-03
Vinyl chloride	138	1.57E-12	4.81E-08	5.22E-10	1.60E-05	3.16E-09	2.59E-04	728	2.68E-06	8.23E-02	1.44E-09	1.18E-04	2.69E-06	8.27E-02
Xylenes, Total	518	NA	9.03E-08	NA	2.48E-07	NA	1.02E-04	---	---	---	---	---	NA	1.03E-04
Organics Total Risk		1.62E-07	2.48E-03	5.40E-07	7.26E-03	8.89E-07	4.84E-02		3.33E-04	4.44E+00	1.85E-08	1.75E-03	3.35E-04	4.50E+00
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	4.66E+03	NA	NA	NA	1.75E-04	NA	1.75E-04
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	4.30E+02	NA	NA	NA	4.74E-04	NA	4.74E-04
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	2.73E+03	NA	NA	NA	1.19E-04	NA	1.19E-04
TPH-GRO	37,150	NA	NA	NA	1.69E-04	NA	2.19E-04	7.82E+03	NA	NA	NA	7.68E-04	NA	1.16E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	3.40E+01	NA	NA	NA	5.62E-05	NA	5.62E-05
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	7.60E-01	NA	NA	NA	5.44E-06	NA	5.44E-06
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	2.50E-03	NA	NA	NA	1.69E-07	NA	1.69E-07
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	8.11E+03	NA	NA	NA	1.62E-04	NA	1.62E-04
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	5.80E+03	NA	NA	NA	8.13E-05	NA	8.13E-05
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	6.50E+02	NA	NA	NA	7.27E-06	NA	7.27E-06
TPH-DRO	521,665	NA	1.15E-03	NA	3.50E-03	NA	1.00E-03	1.46E+04	NA	NA	NA	3.13E-04	NA	5.96E-03
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	2.50E-03	NA	NA	NA	1.69E-07	NA	1.69E-07
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	6.60E+00	NA	NA	NA	6.40E-08	NA	6.40E-08
TPH-ORO	30,667	NA	7.81E-05	NA	2.01E-04	NA	6.33E-06	6.60E+00	NA	NA	NA	2.32E-07	NA	2.86E-04
TPH Total Risk		NA	1.23E-03	NA	3.87E-03	NA	1.23E-03		NA	NA	NA	1.08E-03	NA	7.40E-03

Table 3B-12(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 2B: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Arsenic	10,969	2.46E-08	3.83E-03	8.57E-08	1.33E-02	1.04E-09	1.61E-05	67	NA	NA	NA	NA	1.11E-07	1.72E-02
Cadmium	1,289	NA	4.50E-06	NA	4.50E-04	5.12E-11	1.14E-06	4.0	NA	NA	NA	NA	5.12E-11	4.55E-04
Chromium	22,860	NA	NA	NA	NA	6.05E-09	NA	---	---	---	---	---	6.05E-09	NA
Mercury	194	NA	2.26E-05	NA	2.27E-04	NA	6.54E-03	---	---	---	---	---	NA	6.79E-03
Selenium	909	NA	6.34E-06	NA	6.34E-05	NA	7.03E-06	---	---	---	---	---	NA	7.68E-05
Silver	1,122	NA	7.04E-06	NA	7.83E-05	NA	1.73E-04	---	---	---	---	---	NA	2.58E-04
Antimony	2,513	NA	2.19E-04	NA	2.19E-03	NA	7.78E-05	---	---	---	---	---	NA	2.49E-03
Beryllium	849	3.64E-09	1.48E-05	3.64E-08	1.48E-04	4.49E-11	6.56E-05	---	---	---	---	---	4.00E-08	2.28E-04
Cobalt	6,613	NA	1.15E-03	NA	1.15E-04	4.08E-10	5.12E-04	---	---	---	---	---	4.08E-10	1.78E-03
Copper	11,748	NA	1.02E-05	NA	1.02E-04	NA	1.81E-05	---	---	---	---	---	NA	1.31E-04
Manganese	844,250	NA	1.89E-04	NA	2.10E-03	NA	2.66E-02	---	---	---	---	---	NA	2.89E-02
Nickel	17,715	NA	1.54E-06	NA	3.09E-05	9.37E-11	1.37E-04	---	---	---	---	---	9.37E-11	1.69E-04
Thallium	2,039	NA	8.89E-04	NA	8.89E-03	NA	1.12E-05	---	---	---	---	---	NA	9.79E-03
Zinc	36,425	NA	4.23E-06	NA	4.23E-05	NA	5.35E-08	---	---	---	---	---	NA	4.66E-05
Metals Total Risk		2.82E-08	6.35E-03	1.22E-07	2.78E-02	7.68E-09	3.42E-02		NA	NA	NA	NA	1.58E-07	6.83E-02
CUMULATIVE RISK		1.91E-07	1.01E-02	6.62E-07	3.89E-02	8.96E-07	8.38E-02		3.33E-04	4.44E+00	1.85E-08	2.84E-03	3.35E-04	4.57E+00

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 3C-12(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 2C: Demolished Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Benzene	102	5.33E-11	2.86E-05	1.78E-11	9.52E-06	3.63E-10	1.72E-04	203	9.84E-08	5.28E-02	2.09E-11	9.88E-06	9.89E-08	5.30E-02
Ethylbenzene	172	NA	1.80E-06	NA	6.08E-07	NA	3.87E-06	---	---	---	---	---	NA	6.28E-06
Methylene chloride	5.8	6.50E-13	1.01E-07	2.17E-13	3.37E-08	2.60E-12	9.66E-07	---	---	---	---	---	3.47E-12	1.10E-06
Toluene	762	NA	9.97E-07	NA	3.32E-06	NA	6.03E-06	---	---	---	---	---	NA	1.04E-05
Xylenes, Total	415	NA	7.23E-08	NA	1.99E-07	NA	8.20E-05	---	---	---	---	---	NA	8.23E-05
Organics Total Risk		5.39E-11	3.15E-05	1.80E-11	1.37E-05	3.65E-10	2.65E-04		9.84E-08	5.28E-02	2.09E-11	9.88E-06	9.89E-08	5.31E-02
TPH-GRO	97,167	NA	NA	NA	3.98E-04	NA	4.12E-03	73,658	NA	NA	NA	5.09E-02	NA	5.55E-02
TPH-DRO	177,313	NA	1.17E-03	NA	1.07E-03	NA	2.45E-03	513	NA	NA	NA	1.14E-02	NA	1.61E-02
TPH-ORO	15,167	NA	1.16E-04	NA	8.95E-05	NA	2.25E-05	429	NA	NA	NA	2.54E-02	NA	2.56E-02
TPH Total Risk		NA	1.29E-03	NA	1.56E-03	NA	6.59E-03		NA	NA	NA	8.77E-02	NA	9.72E-02
CUMULATIVE RISK		5.39E-11	1.32E-03	1.80E-11	1.57E-03	3.65E-10	6.86E-03		9.84E-08	5.28E-02	2.09E-11	8.77E-02	9.89E-08	1.50E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum hydrocarbon

Table 4A-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3A: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,2,4-Trimethylbenzene	13	NA	2.67E-07	NA	8.89E-08	NA	1.36E-05	7.8	NA	NA	NA	1.18E-05	NA	2.58E-05
1,3,5-Trimethylbenzene	26	NA	5.35E-07	NA	1.78E-07	NA	6.86E-05	---	---	---	---	---	NA	6.93E-05
Benzene	32	1.66E-11	8.91E-06	5.54E-12	2.97E-06	1.13E-10	5.35E-05	69	3.35E-08	1.80E-02	5.23E-11	2.47E-05	3.37E-08	1.81E-02
cis-1,2-Dichloroethene	---	---	---	---	---	---	---	381	NA	NA	NA	9.68E-05	NA	9.68E-05
Ethylbenzene	11	NA	1.17E-07	NA	3.93E-08	NA	2.50E-07	---	---	---	---	---	NA	4.06E-07
Isopropylbenzene	49	NA	5.17E-07	NA	1.72E-07	NA	8.62E-06	---	---	---	---	---	NA	9.31E-06
m,p-Xylene	11	NA	1.93E-08	NA	1.93E-09	NA	7.53E-07	---	---	---	---	---	NA	7.75E-07
Methylene chloride	48.4	5.42E-12	8.43E-07	1.81E-12	2.81E-07	2.17E-11	8.05E-06	---	---	---	---	---	2.89E-11	9.18E-06
n-Propylbenzene	69	NA	2.17E-06	NA	7.22E-07	NA	9.11E-06	71	NA	NA	NA	6.86E-06	NA	1.88E-05
p-Isopropyltoluene	42	NA	4.40E-07	NA	4.40E-08	NA	4.02E-07	---	---	---	---	---	NA	8.86E-07
sec-Butylbenzene	129	NA	1.13E-05	NA	1.13E-06	NA	1.33E-05	---	---	---	---	---	NA	2.56E-05
Toluene	49.8	NA	6.51E-08	NA	2.17E-07	NA	3.94E-07	---	---	---	---	---	NA	6.76E-07
Vinyl chloride	---	---	---	---	---	---	---	7.3	2.67E-08	8.20E-04	3.20E-11	2.62E-06	2.67E-08	8.23E-04
Xylenes, Total	40	NA	2.10E-07	NA	7.09E-08	NA	7.95E-06	---	---	---	---	---	NA	8.23E-06
Organics Total Risk		2.20E-11	2.54E-05	7.34E-12	5.91E-06	1.35E-10	1.84E-04		6.02E-08	1.88E-02	8.43E-11	1.43E-04	6.05E-08	1.92E-02
TPH-GRO	314,642	NA	NA	NA	1.29E-03	NA	1.33E-02	1,060	NA	NA	NA	9.35E-04	NA	1.56E-02
TPH-DRO	9,714	NA	6.43E-05	NA	5.86E-05	NA	1.34E-04	6,983	NA	NA	NA	1.98E-01	NA	1.99E-01
TPH-ORO	5,286	NA	4.04E-05	NA	3.12E-05	NA	7.86E-06	1,449	NA	NA	NA	1.09E-01	NA	1.09E-01
TPH Total Risk		NA	1.05E-04	NA	1.38E-03	NA	1.35E-02		NA	NA	NA	3.09E-01	NA	3.23E-01
Arsenic	---	---	---	---	---	---	---	100	NA	NA	NA	NA	NA	NA
Mercury	94	NA	1.09E-05	NA	1.10E-04	NA	3.16E-03	---	---	---	---	---	NA	3.28E-03
Metals Total Risk		NA	1.09E-05	NA	1.10E-04	NA	3.16E-03		NA	NA	NA	NA	NA	3.28E-03
CUMULATIVE RISK		2.20E-11	1.41E-04	7.34E-12	1.49E-03	1.35E-10	1.68E-02		6.02E-08	1.88E-02	8.43E-11	3.09E-01	6.05E-08	3.46E-01

Notes:

NA: Not available
 ---: Risk evaluation was not performed.
 HI: Hazard index
 TPH: Total petroleum hydrocarbon
 DRO: Diesel range organic
 GRO: Gasoline range organic
 ORO: Oil range organic
 ug/kg: Micrograms per kilogram
 ug/L: Micrograms per liter

Table 4B-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3B: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	15	NA	1.52E-08	NA	5.28E-09	NA	9.04E-08	---	---	---	---	---	NA	1.11E-07
Benzene	414	2.16E-10	1.16E-04	7.19E-11	3.85E-05	1.47E-09	6.95E-04	---	---	---	---	---	1.76E-09	8.49E-04
Carbon disulfide	4.0	NA	4.18E-08	NA	2.23E-08	NA	7.92E-07	---	---	---	---	---	NA	8.56E-07
Ethylbenzene	32	NA	3.33E-07	NA	1.12E-07	NA	7.15E-07	---	---	---	---	---	NA	1.16E-06
Isopropylbenzene	3.3	NA	3.40E-08	NA	1.13E-08	NA	5.67E-07	---	---	---	---	---	NA	6.13E-07
n-Propylbenzene	2.7	NA	8.47E-08	NA	2.82E-08	NA	3.56E-07	6.1	NA	NA	NA	5.89E-07	NA	1.06E-06
sec-Butylbenzene	7.7	NA	6.71E-07	NA	6.71E-08	NA	7.90E-07	---	---	---	---	---	NA	1.53E-06
Toluene	140	NA	1.83E-07	NA	6.09E-07	NA	1.10E-06	---	---	---	---	---	NA	1.90E-06
Xylenes, Total	282	NA	1.48E-06	NA	4.98E-07	NA	5.58E-05	---	---	---	---	---	NA	5.78E-05
Organics Total Risk		2.16E-10	1.18E-04	7.19E-11	3.99E-05	1.47E-09	7.55E-04		NA	NA	NA	5.89E-07	1.76E-09	9.14E-04
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	2,219	NA	NA	NA	1.86E-04	NA	1.86E-04
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	555	NA	NA	NA	1.37E-03	NA	1.37E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	555	NA	NA	NA	5.38E-05	NA	5.38E-05
TPH-GRO	117,333	NA	NA	NA	5.33E-04	NA	6.91E-04	3,328	NA	NA	NA	1.61E-03	NA	2.83E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	3.26E-04	NA	3.26E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	1.41E-03	NA	1.41E-03
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	1.33E-02	NA	1.33E-02
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	3.92E-06	NA	3.92E-06
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	2.71E-06	NA	2.71E-06
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	88	NA	NA	NA	2.07E-06	NA	2.07E-06
TPH-DRO	11,514	NA	2.54E-05	NA	7.72E-05	NA	2.21E-05	529	NA	NA	NA	1.50E-02	NA	1.52E-02
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	136	NA	NA	NA	2.04E-02	NA	2.04E-02
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	136	NA	NA	NA	1.88E-06	NA	1.88E-06
TPH-ORO	2,930	NA	7.46E-06	NA	1.92E-05	NA	6.05E-07	271	NA	NA	NA	2.04E-02	NA	2.04E-02
TPH Total Risk		NA	3.29E-05	NA	6.30E-04	NA	7.14E-04		NA	NA	NA	3.71E-02	1.76E-09	3.93E-02
CUMULATIVE RISK		2.16E-10	1.51E-04	7.19E-11	6.70E-04	1.47E-09	1.47E-03		NA	NA	NA	3.71E-02	1.76E-09	3.93E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4C-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3C: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	32	NA	3.35E-08	NA	1.17E-08	NA	2.00E-07	---	---	---	---	---	NA	2.45E-07
Benzene	79	4.10E-11	2.20E-05	1.37E-11	7.32E-06	2.79E-10	1.32E-04	120	5.82E-08	3.12E-02	9.08E-11	4.30E-05	5.86E-08	3.14E-02
Isopropylbenzene	17	NA	1.81E-07	NA	6.04E-08	NA	3.03E-06	---	---	---	---	---	NA	3.27E-06
Methylene chloride	22	2.44E-12	3.80E-07	8.15E-13	1.27E-07	9.78E-12	3.63E-06	---	---	---	---	---	1.30E-11	4.14E-06
Methyl tert-butyl ether	14	3.53E-13	1.74E-08	1.18E-13	5.81E-09	1.69E-12	1.52E-07	35	1.72E-10	8.49E-06	6.44E-13	5.76E-08	1.75E-10	8.73E-06
n-Butylbenzene	22	NA	1.95E-06	NA	1.95E-07	NA	1.71E-06	208	NA	NA	NA	2.38E-05	NA	2.77E-05
n-Propylbenzene	30	NA	9.31E-07	NA	3.10E-07	NA	3.91E-06	223	NA	NA	NA	2.15E-05	NA	2.67E-05
sec-Butylbenzene	24	NA	2.07E-06	NA	2.07E-07	NA	2.44E-06	172	NA	NA	NA	2.63E-05	NA	3.10E-05
t-Butylbenzene	5.7	NA	4.94E-07	NA	4.94E-08	NA	4.78E-07	---	---	---	---	---	NA	1.02E-06
Toluene	656	NA	8.58E-07	NA	2.86E-06	NA	5.19E-06	---	---	---	---	---	NA	8.91E-06
Xylenes, Total	259	NA	1.36E-06	NA	4.57E-07	NA	5.13E-05	---	---	---	---	---	NA	5.31E-05
Organics Total Risk		4.38E-11	3.02E-05	1.46E-11	1.16E-05	2.90E-10	2.04E-04		5.84E-08	3.12E-02	9.14E-11	1.15E-04	5.88E-08	3.16E-02
TPH-GRO	47,350	NA	NA	NA	1.94E-04	NA	2.01E-03	24,847	NA	NA	NA	3.36E-03	NA	5.56E-03
TPH-DRO	311,290	NA	2.06E-03	NA	1.88E-03	NA	4.30E-03	31,485	NA	NA	NA	1.44E-03	NA	9.68E-03
TPH-ORO	33,290	NA	2.54E-04	NA	1.96E-04	NA	4.95E-05	6.6	NA	NA	NA	4.68E-07	NA	5.01E-04
TPH Total Risk		NA	2.31E-03	NA	2.27E-03	NA	6.36E-03		NA	NA	NA	4.80E-03	NA	1.57E-02
CUMULATIVE RISK		4.38E-11	2.34E-03	1.46E-11	2.28E-03	2.90E-10	6.56E-03		5.84E-08	3.12E-02	9.14E-11	4.92E-03	5.88E-08	4.73E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4D-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3D: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,1-Dichloroethene	---	---	---	---	---	---	---	2.6	8.29E-09	2.15E-05	2.92E-11	2.05E-07	8.32E-09	2.17E-05
1,2,4-Trimethylbenzene	9,401	NA	1.97E-04	NA	6.56E-05	NA	1.00E-02	---	---	---	---	---	NA	1.03E-02
1,3,5-Trimethylbenzene	26	NA	5.39E-07	NA	1.80E-07	NA	6.91E-05	---	---	---	---	---	NA	6.98E-05
Benzene	6.1	3.19E-12	1.71E-06	1.06E-12	5.70E-07	2.17E-11	1.03E-05	2.1	1.03E-09	5.53E-04	7.23E-13	3.42E-07	1.06E-09	5.66E-04
Chloroethane	2.6	3.68E-13	2.22E-08	3.68E-14	2.22E-09	3.98E-12	3.32E-08	---	---	---	---	---	4.39E-12	5.76E-08
Ethylbenzene	8.1	NA	8.50E-08	NA	2.87E-08	NA	1.82E-07	---	---	---	---	---	NA	2.96E-07
Isopropylbenzene	81	NA	8.47E-07	NA	2.82E-07	NA	1.41E-05	---	---	---	---	---	NA	1.53E-05
m,p-Xylene	21	NA	3.71E-08	NA	3.71E-09	NA	1.44E-06	---	---	---	---	---	NA	1.49E-06
n-Butylbenzene	24	NA	2.07E-06	NA	2.07E-07	NA	4.79E-06	---	---	---	---	---	NA	7.07E-06
n-Propylbenzene	8.4	NA	2.63E-07	NA	8.76E-08	NA	1.11E-06	---	---	---	---	---	NA	1.46E-06
o-Xylene	3.9	NA	6.76E-09	NA	6.76E-10	NA	2.73E-08	---	---	---	---	---	NA	3.47E-08
p-Isopropyltoluene	76	NA	7.98E-07	NA	7.98E-08	NA	7.30E-07	---	---	---	---	---	NA	1.61E-06
sec-Butylbenzene	33	NA	2.84E-06	NA	2.84E-07	NA	3.35E-06	---	---	---	---	---	NA	6.48E-06
tert-Butylbenzene	27	NA	2.38E-06	NA	2.38E-07	NA	2.30E-06	---	---	---	---	---	NA	4.91E-06
Tetrachloroethene	4.1	3.28E-12	4.25E-08	1.09E-11	1.42E-07	1.79E-11	7.85E-07	6.2	1.06E-07	1.37E-03	4.82E-12	2.12E-07	1.06E-07	1.38E-03
Trichloroethene	---	---	---	---	---	---	---	3.3	4.67E-10	1.65E-05	6.30E-13	6.16E-08	4.68E-10	1.66E-05
Vinyl chloride	---	---	---	---	---	---	---	2.9	1.08E-08	3.32E-04	5.80E-12	4.75E-07	1.08E-08	3.33E-04
Xylenes, Total	12	NA	6.28E-08	NA	2.12E-08	NA	2.37E-06	---	---	---	---	---	NA	2.46E-06
Benzo(a)pyrene	85	4.02E-09	NA	3.15E-09	NA	3.39E-11	NA	---	---	---	---	---	7.21E-09	NA
Organics Total Risk		4.03E-09	2.08E-04	3.17E-09	6.77E-05	7.74E-11	1.01E-02		1.27E-07	2.30E-03	4.11E-11	1.29E-06	1.34E-07	1.27E-02
TPH-GRO	500	NA	NA	NA	2.05E-06	NA	2.12E-05	500	NA	NA	NA	1.97E-04	NA	2.20E-04
TPH-DRO	24,770	NA	1.64E-04	NA	1.49E-04	NA	3.42E-04	190	NA	NA	NA	2.41E-03	NA	3.07E-03
TPH-ORO	5,610	NA	4.29E-05	NA	3.31E-05	NA	8.34E-06	75	NA	NA	NA	2.53E-03	NA	2.61E-03
TPH Total Risk		NA	2.07E-04	NA	1.85E-04	NA	3.72E-04		NA	NA	NA	5.14E-03	NA	5.90E-03
Arsenic	11,294	2.53E-08	3.94E-03	8.82E-08	1.37E-02	1.07E-09	1.66E-05	25	NA	NA	NA	NA	1.15E-07	1.77E-02
Barium	---	---	---	---	---	---	---	1,978	NA	NA	NA	NA	NA	NA
Beryllium	470	2.01E-09	8.19E-06	2.01E-08	8.19E-05	2.49E-11	3.63E-05	---	---	---	---	---	2.22E-08	1.26E-04
Cadmium	269	NA	9.37E-07	NA	9.37E-05	1.07E-11	2.37E-07	8.2	NA	NA	NA	NA	1.07E-11	9.48E-05
Chromium	---	---	---	---	---	---	---	67	NA	NA	NA	NA	NA	NA
Copper	13,317	NA	1.16E-05	NA	1.16E-04	NA	2.05E-05	---	---	---	---	---	NA	1.48E-04
Manganese	---	---	---	---	---	---	---	2,156	NA	NA	NA	NA	NA	NA
Nickel	12,247	NA	1.07E-06	NA	2.14E-05	6.48E-11	9.46E-05	---	---	---	---	---	6.48E-11	1.17E-04
Selenium	1,293	NA	9.02E-06	NA	9.02E-05	NA	1.99E-04	---	---	---	---	---	NA	2.99E-04
Thallium	5,967	NA	2.60E-03	NA	2.60E-02	NA	3.29E-05	---	---	---	---	---	NA	2.86E-02
Zinc	39,892	NA	4.64E-06	NA	4.64E-05	NA	5.86E-08	---	---	---	---	---	NA	5.11E-05
Metals Total Risk		2.73E-08	6.57E-03	1.08E-07	4.02E-02	1.17E-09	4.01E-04		NA	NA	NA	NA	1.37E-07	4.72E-02
CUMULATIVE RISK		3.14E-08	6.99E-03	1.11E-07	4.04E-02	1.24E-09	1.09E-02		1.27E-07	2.30E-03	4.11E-11	5.14E-03	2.71E-07	6.58E-02

Notes:

NA: Not available
---: Risk evaluation was not performed.
HI: Hazard index
TPH: Total petroleum hydrocarbon
DRO: Diesel range organic

GRO: Gasoline range organic
ORO: Oil range organic
ug/kg: Micrograms per kilogram
ug/L: Micrograms per liter

Table 4E-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3E: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	2,500	NA	NA	NA	1.69E-03	NA	1.69E-03
Acetone	68	NA	7.11E-08	NA	2.48E-08	NA	4.24E-07	540	NA	NA	NA	2.47E-07	NA	7.67E-07
Benzene	202	1.05E-10	5.64E-05	3.50E-11	1.88E-05	7.15E-10	3.39E-04	---	---	---	---	---	8.55E-10	4.14E-04
Ethylbenzene	725	NA	7.58E-06	NA	2.56E-06	NA	1.63E-05	1,245	NA	4.28E-02	NA	6.00E-06	NA	4.29E-02
Isopropylbenzene	140	NA	1.46E-06	NA	4.88E-07	NA	2.44E-05	---	---	---	---	---	NA	2.64E-05
Methylene chloride	39	1.07E-12	1.67E-07	3.58E-13	5.57E-08	4.30E-12	1.60E-06	---	---	---	---	---	5.73E-12	1.82E-06
Methyl tert-butyl ether	10	1.00E-12	4.95E-08	3.35E-13	1.65E-08	4.82E-12	4.31E-07	---	---	---	---	---	6.16E-12	4.97E-07
m,p-Xylene	---	---	---	---	---	---	---	5,300	NA	9.86E-03	NA	5.59E-05	NA	9.91E-03
Naphthalene	206	NA	4.31E-06	NA	4.31E-06	NA	1.51E-04	930	NA	NA	NA	4.89E-04	NA	6.48E-04
n-Butylbenzene	131	NA	1.14E-05	NA	1.14E-06	NA	9.98E-06	---	---	---	---	---	NA	2.25E-05
n-Propylbenzene	453	NA	1.42E-05	NA	4.74E-06	NA	5.98E-05	380	NA	NA	NA	1.63E-05	NA	9.50E-05
sec-Butylbenzene	52	NA	4.53E-06	NA	4.53E-07	NA	5.33E-06	---	---	---	---	---	NA	1.03E-05
Toluene	115	NA	1.50E-07	NA	5.01E-07	NA	9.10E-07	---	---	---	---	---	NA	1.56E-06
Xylenes, Total	1,533	NA	8.02E-06	NA	2.71E-06	NA	3.03E-04	---	---	---	---	---	NA	3.14E-04
Organics Total Risk		1.07E-10	1.08E-04	3.57E-11	3.58E-05	7.24E-10	9.12E-04		NA	5.27E-02	NA	2.26E-03	8.67E-10	5.60E-02
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	4,917	NA	NA	NA	1.83E-04	NA	1.83E-04
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	4,917	NA	NA	NA	5.38E-03	NA	5.38E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	19,667	NA	NA	NA	8.47E-04	NA	8.47E-04
TPH-GRO	180,057	NA	NA	NA	8.19E-04	NA	1.06E-03	29,500	NA	NA	NA	6.41E-03	NA	8.29E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	1.37E-02	NA	1.37E-02
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	5.92E-02	NA	5.92E-02
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	5.58E-01	NA	5.58E-01
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	1.64E-04	NA	1.64E-04
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	1.14E-04	NA	1.14E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	8,338	NA	NA	NA	8.56E-05	NA	8.56E-05
TPH-DRO	5,304	NA	1.17E-05	NA	3.56E-05	NA	1.02E-05	50,025	NA	NA	NA	6.31E-01	NA	6.31E-01
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	373	NA	NA	NA	2.50E-02	NA	2.50E-02
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	4,477	NA	NA	NA	2.56E-05	NA	2.56E-05
TPH-ORO	5,455	NA	1.39E-05	NA	3.58E-05	NA	1.13E-06	4,850	NA	NA	NA	2.50E-02	NA	2.50E-02
TPH Total Risk		NA	2.56E-05	NA	8.90E-04	NA	1.07E-03		NA	NA	NA	6.62E-01	NA	6.64E-01
CUMULATIVE RISK		1.07E-10	1.34E-04	3.57E-11	9.26E-04	7.24E-10	1.98E-03		NA	5.27E-02	NA	6.65E-01	8.67E-10	7.20E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4F-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3F: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
TPH-GRO	---	---	---	---	---	---	---	500	NA	NA	NA	1.97E-04	NA	1.97E-04
TPH-DRO	---	---	---	---	---	---	---	514	NA	NA	NA	6.53E-03	NA	6.53E-03
TPH-ORO	---	---	---	---	---	---	---	1,543	NA	NA	NA	5.20E-02	NA	5.20E-02
TPH Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	5.87E-02	NA	5.87E-02
CUMULATIVE RISK		NA	NA	NA	NA	NA	NA		NA	NA	NA	5.87E-02	NA	5.87E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4G-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3G: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,2,4-Trimethylbenzene	840	NA	1.76E-05	NA	5.86E-06	NA	8.95E-04	5.5	NA	NA	NA	3.77E-06	NA	9.22E-04
1,3,5-Trimethylbenzene	326	NA	6.83E-06	NA	2.28E-06	NA	8.75E-04	---	---	---	---	---	NA	8.84E-04
Acetone	820	NA	8.58E-07	NA	2.99E-07	NA	5.11E-06	---	---	---	---	---	NA	6.27E-06
Benzene	548	2.85E-10	1.53E-04	9.50E-11	5.09E-05	1.94E-09	9.18E-04	484	2.35E-07	1.26E-01	1.65E-10	7.79E-05	2.37E-07	1.27E-01
Ethylbenzene	1,010	NA	1.06E-05	NA	3.56E-06	NA	2.27E-05	---	---	---	---	---	NA	3.68E-05
m,p-Xylene	2,650	NA	4.62E-06	NA	4.62E-07	NA	1.80E-04	---	---	---	---	---	NA	1.85E-04
Methyl tert-butyl ether	378	9.32E-12	4.60E-07	3.11E-12	1.53E-07	4.47E-11	4.00E-06	---	---	---	---	---	5.72E-11	4.61E-06
Naphthalene	478	NA	9.99E-06	NA	9.99E-06	NA	3.50E-04	---	---	---	---	---	NA	3.70E-04
o-Xylene	1,490	NA	2.60E-06	NA	2.60E-07	NA	1.05E-05	---	---	---	---	---	NA	1.34E-05
p-Isopropyltoluene	416	NA	4.35E-06	NA	4.35E-07	NA	3.98E-06	---	---	---	---	---	NA	8.77E-06
Toluene	5,700	NA	7.45E-06	NA	2.48E-05	NA	4.51E-05	---	---	---	---	---	NA	7.74E-05
Xylenes, Total	3,550	NA	1.86E-05	NA	6.26E-06	NA	7.02E-04	---	---	---	---	---	NA	7.27E-04
Organics Total Risk		2.94E-10	2.37E-04	9.81E-11	1.05E-04	1.98E-09	4.01E-03		2.35E-07	1.26E-01	1.65E-10	8.16E-05	2.37E-07	1.30E-01
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	1,680	NA	NA	NA	6.30E-05	NA	6.30E-05
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	1,680	NA	NA	NA	1.85E-03	NA	1.85E-03
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	1,680	NA	NA	NA	7.31E-05	NA	7.31E-05
TPH-GRO	3,280	NA	NA	NA	1.49E-05	NA	1.93E-05	5,040	NA	NA	NA	1.99E-03	NA	2.02E-03
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	222	NA	NA	NA	3.67E-04	NA	3.67E-04
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	889	NA	NA	NA	6.36E-03	NA	6.36E-03
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	222	NA	NA	NA	1.50E-02	NA	1.50E-02
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	222	NA	NA	NA	4.45E-06	NA	4.45E-06
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	222	NA	NA	NA	3.11E-06	NA	3.11E-06
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	222	NA	NA	NA	2.48E-06	NA	2.48E-06
TPH-DRO	85,750	NA	1.89E-04	NA	5.75E-04	NA	1.65E-04	2,000	NA	NA	NA	2.17E-02	NA	2.26E-02
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	2,432	NA	NA	NA	1.64E-01	NA	1.64E-01
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	608	NA	NA	NA	5.76E-06	NA	5.76E-06
TPH-ORO	1,470,000	NA	3.75E-03	NA	9.64E-03	NA	3.04E-04	3,040	NA	NA	NA	1.64E-01	NA	1.78E-01
TPH Total Risk		NA	3.93E-03	NA	1.02E-02	NA	4.87E-04		NA	NA	NA	1.88E-01	NA	2.02E-01
CUMULATIVE RISK		2.94E-10	4.17E-03	9.81E-11	1.03E-02	1.98E-09	4.50E-03		2.35E-07	1.26E-01	1.65E-10	1.88E-01	2.37E-07	3.33E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 4H-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 3H: Retained Area, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	21	NA	2.20E-08	NA	7.65E-09	NA	1.31E-07	---	---	---	---	---	NA	1.61E-07
Methyl ethyl ketone (MEK)	8.8	NA	1.53E-08	NA	5.11E-09	NA	2.85E-08	---	---	---	---	---	NA	4.90E-08
Methylene chloride	4.5	5.04E-13	7.85E-08	1.68E-13	2.62E-08	2.02E-12	7.50E-07	---	---	---	---	---	2.69E-12	8.54E-07
Xylenes, total	6.0	NA	3.11E-08	NA	1.05E-08	NA	1.18E-06	---	---	---	---	---	NA	1.22E-06
Organics Total Risk		5.04E-13	1.47E-07	1.68E-13	4.94E-08	2.02E-12	2.09E-06		NA	NA	NA	NA	2.69E-12	2.28E-06
TPH-GRO	375	NA	NA	NA	1.53E-06	NA	1.59E-05	275	NA	NA	NA	3.59E-05	NA	5.33E-05
TPH-DRO	36,120	NA	2.39E-04	NA	2.18E-04	NA	4.99E-04	2,520	NA	NA	NA	3.18E-02	NA	3.27E-02
TPH-ORO	3,159	NA	2.41E-05	NA	1.86E-05	NA	4.70E-06	213	NA	NA	NA	7.12E-03	NA	7.17E-03
TPH Total Risk		NA	2.63E-04	NA	2.38E-04	NA	5.20E-04		NA	NA	NA	3.89E-02	NA	4.00E-02
Arsenic	---	---	---	---	---	---	---	80	NA	NA	NA	NA	NA	NA
Manganese	---	---	---	---	---	---	---	8,860	NA	NA	NA	NA	NA	NA
Metals Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA
CUMULATIVE RISK		5.04E-13	2.63E-04	1.68E-13	2.38E-04	2.02E-12	5.22E-04		NA	NA	NA	3.89E-02	2.69E-12	4.00E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 5-9(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Futue Construction Worker
Area 4: Power Plant, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	22	NA	2.34E-08	NA	8.14E-09	NA	1.39E-07	---	---	---	---	---	NA	1.71E-07
Methyl ethyl ketone (MEK)	6.3	NA	1.10E-08	NA	3.66E-09	NA	2.04E-08	---	---	---	---	---	NA	3.51E-08
Methylene chloride	3.3	3.67E-13	5.70E-08	1.22E-13	1.90E-08	1.47E-12	5.45E-07	---	---	---	---	---	1.96E-12	6.21E-07
Toluene	5.0	NA	6.49E-09	NA	2.16E-08	NA	3.92E-08	---	---	---	---	---	NA	6.73E-08
Xylenes, total	4.2	NA	4.92E-09	NA	1.35E-08	NA	5.58E-07	---	---	---	---	---	NA	5.77E-07
Anthracene	3.0	NA	4.16E-09	NA	3.46E-09	NA	1.49E-09	---	---	---	---	---	NA	9.11E-09
Benzo(a)anthracene	5.1	2.41E-11	NA	1.85E-11	NA	3.26E-13	NA	5.5	2.16E-06	NA	6.60E-12	NA	2.16E-06	NA
Benzo(a)pyrene	7.5	3.55E-10	NA	2.79E-10	NA	2.99E-12	NA	---	---	---	---	---	6.37E-10	NA
Benzo(b)fluoranthene	28	1.34E-10	NA	1.03E-10	NA	1.38E-12	NA	5.4	3.16E-06	NA	6.41E-12	NA	3.16E-06	NA
Benzo(g,h,i)perylene	13	NA	1.56E-06	NA	1.56E-07	NA	6.61E-09	---	---	---	---	---	NA	1.73E-06
Benzo(k)fluoranthene	2.8	1.31E-12	NA	1.01E-12	NA	8.53E-14	NA	---	---	---	---	---	2.41E-12	NA
Chrysene	7.1	3.37E-13	NA	2.59E-13	NA	6.33E-14	NA	---	---	---	---	---	6.59E-13	NA
Dibenzo(a,h)anthracene	35	1.65E-09	NA	1.27E-09	NA	7.05E-12	NA	---	---	---	---	---	2.92E-09	NA
Fluoranthene	11	NA	1.21E-07	NA	9.34E-08	NA	5.86E-09	---	---	---	---	---	NA	2.21E-07
Indeno(1,2,3-cd)pyrene	5.9	4.44E-11	NA	3.41E-11	NA	1.08E-13	NA	---	---	---	---	---	7.86E-11	NA
Phenanthrene	24	NA	2.83E-06	NA	2.83E-07	NA	8.62E-08	---	---	---	---	---	NA	3.20E-06
Pyrene	21	NA	3.10E-07	NA	2.39E-07	NA	1.51E-08	---	---	---	---	---	NA	5.64E-07
Carbazole	---	---	---	---	---	---	---	6.4	NA	NA	3.09E-13	NA	3.09E-13	NA
Organics Total Risk		2.21E-09	4.93E-06	1.70E-09	8.41E-07	1.35E-11	1.42E-06		5.32E-06	NA	1.33E-11	NA	5.33E-06	7.19E-06
TPH-GRO	375	NA	NA	NA	1.53E-06	NA	1.59E-05	388	NA	NA	NA	1.52E-04	NA	1.69E-04
TPH-DRO	36,120	NA	2.39E-04	NA	2.18E-04	NA	4.99E-04	1,683	NA	NA	NA	2.12E-02	NA	2.22E-02
TPH-ORO	3,159	NA	2.41E-05	NA	1.86E-05	NA	4.70E-06	238	NA	NA	NA	7.97E-03	NA	8.02E-03
TPH Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	2.94E-02	NA	3.04E-02
Arsenic	7,508	1.68E-08	2.62E-03	5.33E-08	8.29E-03	7.10E-10	1.10E-05	48	NA	NA	NA	NA	7.08E-08	1.09E-02
Manganese	---	---	---	---	---	---	---	4,864	NA	NA	NA	NA	NA	NA
Selenium	1,262	NA	8.80E-06	NA	8.80E-05	NA	1.95E-04	---	---	---	---	---	NA	2.91E-04
Metals Total Risk		1.68E-08	2.63E-03	5.33E-08	8.38E-03	7.10E-10	2.06E-04		NA	NA	NA	NA	7.08E-08	1.12E-02
CUMULATIVE RISK		1.90E-08	2.63E-03	5.50E-08	8.38E-03	7.23E-10	2.07E-04		5.32E-06	NA	1.33E-11	2.94E-02	5.40E-06	4.16E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 6-8(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Area 5: IWTP, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
TPH-GRO	93,000	NA	NA	NA	3.81E-04	NA	2.16E-03	---	---	---	---	---	NA	2.54E-03
TPH-DRO	200,000	NA	1.32E-03	NA	1.21E-03	NA	1.54E-03	---	---	---	---	---	NA	4.07E-03
TPH Total Risk		NA	1.32E-03	NA	1.59E-03	NA	3.69E-03		NA	NA	NA	NA	NA	6.60E-03
Arsenic	8,042	1.80E-08	2.80E-03	6.28E-08	9.77E-03	7.60E-10	1.18E-05	---	---	---	---	---	8.16E-08	1.26E-02
Chromium	---	---	---	---	---	---	---	170	NA	NA	NA	NA	NA	NA
Mercury	62	NA	7.20E-06	NA	7.23E-05	NA	2.08E-03	---	---	---	---	---	NA	2.16E-03
Nickel	13,050	NA	1.14E-06	NA	2.28E-05	6.91E-11	1.01E-04	---	---	---	---	---	6.91E-11	1.25E-04
Selenium	1,170	NA	8.16E-06	NA	8.16E-05	NA	9.07E-06	---	---	---	---	---	NA	9.89E-05
Cyanide, total	641	NA	NA	NA	NA	NA	NA	---	---	---	---	---	NA	NA
Organics Total Risk		1.80E-08	2.82E-03	6.28E-08	9.95E-03	8.29E-10	2.20E-03		NA	NA	NA	NA	8.17E-08	1.50E-02
CUMULATIVE RISK		1.80E-08	4.14E-03	6.28E-08	1.15E-02	8.29E-10	5.90E-03		NA	NA	NA	NA	8.17E-08	2.16E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 7A-10(b)
 Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
 Sub-area 6A: GKN Facility, Boeing Tract I, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	30.5	NA	3.19E-08	NA	1.11E-08	NA	1.90E-07	---	---	---	---	---	NA	2.33E-07
Benzene	---	---	---	---	---	---	---	0.76	3.69E-10	1.98E-04	2.57E-13	1.21E-07	3.69E-10	1.98E-04
Chrysene	1,500	7.09E-11	NA	5.46E-11	NA	1.33E-11	NA	---	---	---	---	---	1.39E-10	NA
Methyl ethyl ketone (MEK)	17.5	NA	3.05E-08	NA	1.02E-08	NA	5.67E-08	---	---	---	---	---	NA	9.74E-08
Organics Total Risk		7.09E-11	6.24E-08	5.46E-11	2.13E-08	1.33E-11	2.47E-07		3.69E-10	1.98E-04	2.57E-13	1.21E-07	5.08E-10	1.98E-04
TPH-GRO	---	---	---	---	---	---	---	730	NA	NA	NA	2.87E-04	NA	2.87E-04
TPH-DRO	---	---	---	---	---	---	---	250	NA	NA	NA	3.16E-03	NA	3.16E-03
TPH Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	3.45E-03	NA	3.45E-03
Arsenic	6,700	1.50E-08	2.34E-03	5.23E-08	8.14E-03	6.33E-10	9.85E-06	102	NA	NA	NA	NA	6.80E-08	1.05E-02
Barium	---	---	---	---	---	---	---	11,567	NA	NA	NA	NA	NA	NA
Cadmium	---	---	---	---	---	---	---	7.5	NA	NA	NA	NA	NA	NA
Chromium	---	---	---	---	---	---	---	539	NA	NA	NA	NA	NA	NA
Selenium	353	NA	2.46E-06	NA	2.46E-05	NA	2.73E-06	---	---	---	---	---	NA	2.98E-05
Metals Total Risk		1.50E-08	2.34E-03	5.23E-08	8.16E-03	6.33E-10	1.26E-05		NA	NA	NA	NA	6.80E-08	1.05E-02
CUMULATIVE RISK		1.51E-08	2.34E-03	5.24E-08	8.16E-03	6.46E-10	1.28E-05		3.69E-10	1.98E-04	2.57E-13	3.45E-03	6.85E-08	1.42E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 7B-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 6B: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
1,1-Dichloroethane	3.0	NA	1.06E-07	NA	1.06E-08	NA	3.75E-06	---	---	---	---	---	NA	3.87E-06
1,1-Dichloroethene	2.9	2.58E-11	6.70E-08	8.61E-12	2.23E-08	2.24E-10	1.57E-06	8.0	5.08E-08	1.32E-04	1.66E-10	1.17E-06	5.12E-08	1.35E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	---	---	---	---	---	---	---	640	NA	NA	NA	3.46E-06	NA	3.46E-06
1,2,3-Trimethylbenzene	---	---	---	---	---	---	---	0.7	NA	NA	NA	6.34E-07	NA	6.34E-07
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	3.4	NA	NA	NA	4.27E-06	NA	4.27E-06
Acetone	30	NA	3.10E-08	NA	1.08E-08	NA	1.85E-07	---	---	---	---	---	NA	2.27E-07
Benzene	---	---	---	---	---	---	---	13	6.46E-09	3.47E-03	8.40E-12	3.97E-06	6.47E-09	3.47E-03
Bromomethane	---	---	---	---	---	---	---	14	NA	1.65E-03	NA	2.68E-05	NA	1.68E-03
cis-1,2-Dichloroethene	87	NA	9.05E-07	NA	3.02E-06	NA	1.22E-04	582	NA	NA	NA	1.23E-04	NA	2.49E-04
Dichlorodifluoromethane	---	---	---	---	---	---	---	35	NA	9.79E-05	NA	1.55E-05	NA	1.13E-04
Ethylbenzene	63	NA	6.55E-07	NA	2.21E-07	NA	1.41E-06	---	---	---	---	---	NA	2.28E-06
Methyl ethyl ketone (MEK)	11.8	NA	2.05E-08	NA	6.84E-09	NA	3.81E-08	---	---	---	---	---	NA	6.55E-08
Methyl tert-butyl ether (MTBE)	---	---	---	---	---	---	---	32	1.56E-10	7.68E-06	4.85E-13	4.34E-08	1.56E-10	7.72E-06
Methylene chloride	6.2	6.96E-13	1.08E-07	2.32E-13	3.61E-08	2.79E-12	1.03E-06	13	4.41E-09	6.87E-04	5.84E-13	2.17E-07	4.42E-09	6.88E-04
Tetrachloroethene	5.47	4.42E-12	5.72E-08	1.47E-11	1.91E-07	2.41E-11	1.06E-06	20	3.37E-07	4.37E-03	2.85E-11	1.25E-06	3.37E-07	4.37E-03
Toluene	2,448	NA	3.20E-06	NA	1.07E-05	NA	1.94E-05	---	---	---	---	---	NA	3.32E-05
trans-1,2-Dichlorobenzene	9	NA	1.04E-07	NA	1.73E-08	NA	3.73E-07	---	---	---	---	---	NA	4.94E-07
trans-1,2-Dichloroethene	36	NA	1.88E-07	NA	6.28E-07	NA	3.13E-05	58	NA	NA	NA	9.59E-06	NA	4.17E-05
Trichloroethene	21	6.87E-15	2.43E-10	1.37E-12	4.86E-08	2.39E-11	2.34E-06	112	1.57E-08	5.55E-04	3.93E-11	3.85E-06	1.58E-08	5.61E-04
Vinyl chloride	27	3.05E-13	9.35E-09	1.02E-10	3.12E-06	6.15E-10	5.03E-05	149	5.48E-07	1.68E-02	5.48E-10	4.48E-05	5.49E-07	1.69E-02
Xylenes, Total	202	NA	1.06E-06	NA	3.57E-07	NA	4.00E-05	---	---	---	---	---	NA	4.14E-05
Aroclor 1254	100	1.39E-09	2.44E-03	9.96E-10	1.74E-03	1.26E-12	2.20E-06	296	NA	NA	NA	NA	2.39E-09	4.19E-03
Acenaphthene	721	NA	5.03E-06	NA	4.19E-06	NA	2.10E-06	---	---	---	---	---	NA	1.13E-05
Acenaphthylene	29	NA	1.69E-06	NA	1.69E-07	NA	7.69E-08	---	---	---	---	---	NA	1.93E-06
Benzo(a)anthracene	103	4.87E-10	NA	3.75E-10	NA	6.60E-12	NA	126	4.96E-05	NA	3.11E-10	NA	4.96E-05	NA
Benzo(b)fluoranthene	102	4.82E-10	NA	3.71E-10	NA	4.98E-12	NA	---	---	---	---	---	8.58E-10	NA
Chrysene	159	7.52E-12	NA	5.78E-12	NA	1.41E-12	NA	---	---	---	---	---	1.47E-11	NA
Fluoranthene	146	NA	1.65E-06	NA	1.27E-06	NA	7.98E-08	---	---	---	---	---	NA	3.01E-06
Fluorene	109	NA	1.14E-06	NA	9.50E-07	NA	2.40E-07	---	---	---	---	---	NA	2.33E-06
Phenanthrene	17	NA	1.98E-06	NA	1.98E-07	NA	6.02E-08	---	---	---	---	---	NA	2.23E-06
Pyrene	136	NA	2.06E-06	NA	1.58E-06	NA	1.00E-07	---	---	---	---	---	NA	3.74E-06
Organics Total Risk		2.40E-09	2.46E-03	1.87E-09	1.77E-03	9.04E-10	2.80E-04		5.05E-05	2.78E-02	1.10E-09	2.39E-04	5.06E-05	3.25E-02
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	885	NA	NA	NA	6.19E-05	NA	6.19E-05
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	55	NA	NA	NA	1.14E-04	NA	1.14E-04
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	55	NA	NA	NA	4.48E-06	NA	4.48E-06
TPH-GRO	1,835	NA	NA	NA	8.34E-06	NA	1.08E-05	996	NA	NA	NA	1.80E-04	NA	1.99E-04
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	1.72E-02	NA	1.72E-02
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	7.43E-02	NA	7.43E-02
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	7.00E-01	NA	7.00E-01
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	2.07E-04	NA	2.07E-04
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	1.43E-04	NA	1.43E-04
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	5,575	NA	NA	NA	1.09E-04	NA	1.09E-04
TPH-DRO	137,545	NA	3.03E-04	NA	9.22E-04	NA	2.64E-04	33,451	NA	NA	NA	7.92E-01	NA	7.93E-01
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	75	NA	NA	NA	9.42E-03	NA	9.42E-03
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	75	NA	NA	NA	8.66E-07	NA	8.66E-07
TPH-ORO	---	---	---	---	---	---	---	150	NA	NA	NA	9.42E-03	NA	9.42E-03
TPH Total Risk		NA	3.03E-04	NA	9.31E-04	NA	2.75E-04		NA	NA	NA	8.02E-01	NA	8.03E-01

Table 7B-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 6B: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Arsenic	14,266	3.20E-08	4.97E-03	1.11E-07	1.73E-02	1.35E-09	2.10E-05	108	NA	NA	NA	NA	1.45E-07	2.23E-02
Barium	---	---	---	---	---	---	---	5,440	NA	NA	NA	NA	NA	NA
Cadmium	481	NA	1.68E-06	NA	1.68E-04	1.91E-11	4.25E-07	1,177	NA	NA	NA	NA	1.91E-11	1.70E-04
Chromium	---	---	---	---	---	---	---	412	NA	NA	NA	NA	NA	NA
Mercury	42	NA	4.94E-06	NA	4.96E-05	NA	1.43E-03	1.2	NA	NA	NA	2.37E-05	NA	1.51E-03
Selenium	920	NA	6.42E-06	NA	6.42E-05	NA	7.12E-06	---	---	---	---	---	NA	7.77E-05
Antimony	3,964	NA	3.46E-04	NA	3.46E-03	NA	1.23E-04	---	---	---	---	---	NA	3.92E-03
Beryllium	937	4.01E-09	1.63E-05	4.01E-08	1.63E-06	4.96E-11	7.24E-05	---	---	---	---	---	4.42E-08	9.03E-05
Cobalt	8,404	NA	1.47E-03	NA	1.47E-04	5.19E-10	6.50E-04	---	---	---	---	---	5.19E-10	2.26E-03
Copper	19,350	NA	1.69E-05	NA	1.69E-04	NA	2.98E-05	---	---	---	---	---	NA	2.15E-04
Manganese	1,084,100	NA	2.43E-04	NA	2.70E-03	NA	3.41E-02	6,400	NA	NA	NA	NA	NA	3.71E-02
Nickel	28,150	NA	2.45E-06	NA	4.91E-05	1.49E-10	2.17E-04	---	---	---	---	---	1.49E-10	2.69E-04
Zinc	52,140	NA	6.06E-06	NA	6.06E-05	NA	7.66E-08	---	---	---	---	---	NA	6.67E-05
Metals Total Risk		3.60E-08	7.08E-03	1.52E-07	2.42E-02	2.08E-09	3.67E-02		NA	NA	NA	2.37E-05	1.90E-07	6.80E-02
CUMULATIVE RISK		3.84E-08	9.85E-03	1.53E-07	2.69E-02	2.99E-09	3.73E-02		5.05E-05	2.78E-02	1.10E-09	8.02E-01	5.07E-05	9.04E-01

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 7C-10(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 6C: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
2-Hexanone (MBK)	---	---	---	---	---	---	---	4.3	NA	NA	NA	1.28E-06	NA	1.28E-06
Acetone	27	NA	2.81E-08	NA	9.78E-09	NA	1.67E-07	---	---	---	---	---	NA	2.05E-07
Chloroform	2.9	1.36E-12	3.05E-07	4.52E-13	1.02E-07	5.07E-11	3.08E-06	---	---	---	---	---	5.25E-11	3.48E-06
cis-1,2-Dichloroethene	3.5	NA	3.63E-08	NA	1.21E-07	NA	4.90E-06	96	NA	NA	NA	1.07E-05	NA	1.58E-05
Dichlorodifluoromethane	3.6	NA	6.28E-08	NA	6.28E-09	NA	3.43E-06	---	---	---	---	---	NA	3.49E-06
Ethylbenzene	233	NA	2.44E-06	NA	8.23E-07	NA	5.23E-06	---	---	---	---	---	NA	8.50E-06
Methyl ethyl ketone (MEK)	12	NA	2.16E-08	NA	7.20E-09	NA	4.02E-08	---	---	---	---	---	NA	6.89E-08
Methyl isobutyl ketone	12	NA	1.63E-07	NA	5.42E-08	NA	2.22E-08	---	---	---	---	---	NA	2.39E-07
o-Xylene	600	NA	1.05E-06	NA	1.05E-07	NA	4.23E-06	---	---	---	---	---	NA	5.38E-06
Trichloroethene	29	9.68E-15	3.42E-10	1.94E-12	6.84E-08	3.37E-11	3.30E-06	240	3.36E-08	1.19E-03	4.48E-11	4.38E-06	3.37E-08	1.20E-03
Vinyl chloride	---	---	---	---	---	---	---	5.2	1.91E-08	5.87E-04	1.02E-11	8.32E-07	1.91E-08	5.88E-04
Xylenes, Total	90	NA	4.72E-07	NA	1.59E-07	NA	1.78E-05	---	---	---	---	---	NA	1.85E-05
Benzo(a)anthracene	66	3.13E-10	NA	2.41E-10	NA	4.24E-12	NA	---	---	---	---	---	5.58E-10	NA
Benzo(b)fluoranthene	48	2.26E-10	NA	1.74E-10	NA	2.33E-12	NA	---	---	---	---	---	4.02E-10	NA
Chrysene	274	1.29E-11	NA	9.96E-12	NA	2.43E-12	NA	---	---	---	---	---	2.53E-11	NA
Fluoranthene	84	NA	9.54E-07	NA	7.34E-07	NA	4.60E-08	---	---	---	---	---	NA	1.73E-06
Organics Total Risk		5.53E-10	5.53E-06	4.27E-10	2.19E-06	9.34E-11	4.23E-05		5.28E-08	1.78E-03	5.50E-11	1.72E-05	5.39E-08	1.84E-03
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	110	NA	NA	NA	4.09E-06	NA	4.09E-06
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	47	NA	NA	NA	5.09E-05	NA	5.09E-05
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	47	NA	NA	NA	2.00E-06	NA	2.00E-06
TPH-GRO	45,807	NA	NA	NA	2.08E-04	NA	2.70E-04	203	NA	NA	NA	5.69E-05	NA	5.35E-04
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	1,497	NA	NA	NA	2.45E-03	NA	2.45E-03
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	4,641	NA	NA	NA	3.29E-02	NA	3.29E-02
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	1,497	NA	NA	NA	1.00E-01	NA	1.00E-01
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	1,497	NA	NA	NA	2.95E-05	NA	2.95E-05
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	1,946	NA	NA	NA	2.64E-05	NA	2.64E-05
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	1,497	NA	NA	NA	1.52E-05	NA	1.52E-05
TPH-DRO	1,049,429	NA	2.31E-03	NA	7.04E-03	NA	2.01E-03	12,575	NA	NA	NA	1.36E-01	NA	1.47E-01
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	727	NA	NA	NA	4.86E-02	NA	4.86E-02
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	295	NA	NA	NA	1.62E-06	NA	1.62E-06
TPH-ORO	---	NA	NA	NA	NA	NA	NA	1,022	NA	NA	NA	4.86E-02	NA	4.86E-02
TPH Total Risk		NA	2.31E-03	NA	7.25E-03	NA	2.28E-03		NA	NA	NA	1.84E-01	NA	1.96E-01
Arsenic	5,817	1.30E-08	2.03E-03	4.54E-08	7.07E-03	5.50E-10	8.55E-06	81	NA	NA	NA	NA	5.90E-08	9.10E-03
Barium	---	---	---	---	---	---	---	2,574	NA	NA	NA	NA	NA	NA
Cadmium	425	NA	1.48E-06	NA	1.48E-04	1.68E-11	3.74E-07	669	NA	NA	NA	NA	1.68E-11	1.50E-04
Chromium	19,798	NA	NA	NA	NA	5.24E-09	NA	2,381	NA	NA	NA	NA	5.24E-09	NA
Chromium, hexavalent	---	---	---	---	---	---	---	16	NA	NA	NA	NA	NA	NA
Mercury	38	NA	4.44E-06	NA	4.46E-05	NA	1.28E-03	0.76	NA	NA	NA	8.21E-06	NA	1.34E-03
Selenium	329	NA	2.30E-06	NA	2.30E-05	NA	2.55E-06	---	---	---	---	---	NA	2.78E-05
Metals Total Risk		1.30E-08	2.04E-03	4.54E-08	7.28E-03	5.81E-09	1.30E-03		NA	NA	NA	8.21E-06	6.43E-08	1.06E-02
CUMULATIVE RISK		1.36E-08	4.36E-03	4.58E-08	1.45E-02	5.90E-09	3.62E-03		5.28E-08	1.78E-03	5.50E-11	1.84E-01	1.18E-07	2.08E-01

Notes:

NA: Not available
 ---: Risk evaluation was not performed.
 HI: Hazard index

TPH: Total petroleum hydrocarbon
 GRO: Gasoline range organic
 DRO: Diesel range organic

ORO: Oil range organic
 ug/L: Micrograms per liter
 ug/kg: Micrograms per kilogram

Table 7D-10(b)
 Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
 Sub-area 6D: GKN Facility, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Dichlorodifluoromethane	5.5	NA	9.50E-08	NA	9.50E-09	NA	5.19E-06	---	---	---	---	---	NA	5.29E-06
Methyl ethyl ketone (MEK)	69	NA	1.19E-07	NA	3.98E-08	NA	2.22E-07	---	---	---	---	---	NA	3.81E-07
Tetrachloroethene	---	---	---	---	---	---	---	12	2.01E-07	2.60E-03	9.04E-12	3.97E-07	2.01E-07	2.60E-03
Toluene	27	NA	3.50E-08	NA	1.17E-07	NA	2.11E-07	---	---	---	---	---	NA	3.63E-07
Organics Total Risk		NA	2.49E-07	NA	1.66E-07	NA	5.62E-06		2.01E-07	2.60E-03	9.04E-12	3.97E-07	2.01E-07	2.60E-03
TPH-GRO	12,000	NA	NA	NA	4.91E-05	NA	5.09E-04	---	---	---	---	---	NA	5.58E-04
TPH-DRO	2,500	NA	1.65E-05	NA	1.51E-05	NA	3.45E-05	---	---	---	---	---	NA	6.62E-05
TPH-ORO	2,500	NA	1.91E-05	NA	1.47E-05	NA	3.72E-06	---	---	---	---	---	NA	3.76E-05
TPH Total Risk		NA	3.56E-05	NA	7.89E-05	NA	5.47E-04		NA	NA	NA	NA	NA	6.62E-04
Arsenic	9,250	2.07E-08	3.23E-03	7.22E-08	1.12E-02	8.74E-10	1.36E-05	8.9	NA	NA	NA	NA	9.38E-08	1.45E-02
Chromium	---	---	---	---	---	---	---	41	NA	NA	NA	NA	NA	NA
Metals Total Risk		2.07E-08	3.23E-03	7.22E-08	1.12E-02	8.74E-10	1.36E-05		NA	NA	NA	NA	9.38E-08	1.45E-02
CUMULATIVE RISK		2.07E-08	3.26E-03	7.22E-08	1.13E-02	8.74E-10	5.66E-04		2.01E-07	2.60E-03	9.04E-12	3.97E-07	2.95E-07	1.77E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

ug/L: Micrograms per liter

ug/kg: Micrograms per kilogram

Table 9A-11(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 8A: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	71	NA	7.45E-08	NA	2.60E-08	NA	4.44E-07	---	---	---	---	---	NA	5.45E-07
cis-1,2-Dichloroethene	38	NA	4.01E-07	NA	1.34E-06	NA	5.43E-05	---	---	---	---	---	NA	5.60E-05
Methyl ethyl ketone (MEK)	61	NA	1.07E-07	NA	3.56E-08	NA	1.99E-07	---	---	---	---	---	NA	3.41E-07
Methylene Chloride	7.3	8.13E-13	1.26E-07	2.71E-13	4.21E-08	3.25E-12	1.21E-06	---	---	---	---	---	4.34E-12	1.38E-06
Trichloroethene	34	1.13E-14	3.98E-10	2.25E-12	7.97E-08	3.92E-11	3.84E-06	110	1.55E-08	5.47E-04	4.23E-11	4.14E-06	1.56E-08	5.56E-04
Toluene	---	---	---	---	---	---	---	1.5	NA	3.82E-05	NA	3.72E-09	NA	3.82E-05
Vinyl chloride	---	---	---	---	---	---	---	1.9	7.04E-09	2.16E-04	7.67E-12	6.28E-07	7.05E-09	2.17E-04
Organics Total Risk		8.24E-13	7.10E-07	2.53E-12	1.52E-06	4.25E-11	5.99E-05		2.25E-08	8.02E-04	5.00E-11	4.77E-06	2.26E-08	8.69E-04
Arsenic	11,057	2.48E-08	3.86E-03	8.63E-08	1.34E-02	1.04E-09	1.63E-05	23	NA	NA	NA	NA	1.12E-07	1.73E-02
Barium	---	---	---	---	---	---	---	860	NA	NA	NA	NA	NA	NA
Chromium	---	---	---	---	---	---	---	110	NA	NA	NA	NA	NA	NA
Manganese	---	---	---	---	---	---	---	1,300	NA	NA	NA	NA	NA	NA
Mercury	43	NA	4.98E-06	NA	5.01E-05	NA	1.44E-03	---	---	---	---	---	NA	1.50E-03
Organics Total Risk		2.48E-08	3.86E-03	8.63E-08	1.35E-02	1.04E-09	1.46E-03		NA	NA	NA	NA	1.12E-07	1.88E-02
CUMULATIVE RISK		2.48E-08	3.86E-03	8.63E-08	1.35E-02	1.09E-09	1.52E-03		2.25E-08	8.02E-04	5.00E-11	4.77E-06	1.35E-07	1.97E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 9B-11(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 8B: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Methyl ethyl ketone (MEK)	11	NA	1.96E-08	NA	6.54E-09	NA	3.65E-08	---	---	---	---	---	NA	6.26E-08
Benzo(b)fluoranthene	66	3.12E-10	NA	2.40E-10	NA	3.22E-12	NA	---	---	---	---	---	5.55E-10	NA
Chrysene	44	2.08E-12	NA	1.60E-12	NA	3.91E-13	NA	---	---	---	---	---	4.07E-12	NA
Organics Total Risk		3.14E-10	1.96E-08	2.42E-10	6.54E-09	3.61E-12	3.65E-08		NA	NA	NA	NA	5.59E-10	6.26E-08
Aliphatics > nC6 to nC8 (TX1006)	---	---	---	---	---	---	---	8.33E+01	NA	NA	NA	3.13E-06	NA	3.13E-06
Aliphatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	8.33E+01	NA	NA	NA	9.19E-05	NA	9.19E-05
Aromatics > nC8 to nC10 (TX1006)	---	---	---	---	---	---	---	8.33E+01	NA	NA	NA	3.63E-06	NA	3.63E-06
TPH-GRO								2.50E+02	NA	NA	NA	9.87E-05	NA	9.87E-05
Aliphatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	3.40E+01	NA	NA	NA	5.62E-05	NA	5.62E-05
Aliphatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	7.60E-01	NA	NA	NA	5.44E-06	NA	5.44E-06
Aliphatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	2.50E-03	NA	NA	NA	1.69E-07	NA	1.69E-07
Aromatics > nC10 to nC12 (TX1006)	---	---	---	---	---	---	---	4.67E+02	NA	NA	NA	9.37E-06	NA	9.37E-06
Aromatics > nC12 to nC16 (TX1006)	---	---	---	---	---	---	---	3.74E+03	NA	NA	NA	5.25E-05	NA	5.25E-05
Aromatics > nC16 to nC21 (TX1006)	---	---	---	---	---	---	---	6.50E+02	NA	NA	NA	7.34E-06	NA	7.34E-06
TPH-DRO								4.89E+03	NA	NA	NA	1.31E-04	NA	1.31E-04
Aliphatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	2.50E-03	NA	NA	NA	1.69E-07	NA	1.69E-07
Aromatics > nC21 to nC35 (TX1006)	---	---	---	---	---	---	---	6.60E+00	NA	NA	NA	6.89E-08	NA	6.89E-08
TPH-ORO								6.60E+00	NA	NA	NA	2.38E-07	NA	2.38E-07
TPH Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	2.30E-04	NA	2.30E-04
Arsenic	---	---	---	---	---	---	---	15	NA	NA	NA	NA	NA	NA
Chromium	---	---	---	---	---	---	---	51	NA	NA	NA	NA	NA	NA
Mercury	---	---	---	---	---	---	---	---	---	---	---	---	NA	NA
Organics Total Risk		NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA
CUMULATIVE RISK		3.14E-10	1.96E-08	2.42E-10	6.54E-09	3.61E-12	3.65E-08		NA	NA	NA	2.30E-04	5.59E-10	2.30E-04

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

DRO: Diesel range organic

GRO: Gasoline range organic

ORO: Oil range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 9C-11(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Sub-area 8C: Office Complex North, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	67	NA	7.01E-08	NA	2.44E-08	NA	4.18E-07	---	---	---	---	---	NA	5.12E-07
Tetrachloroethene	3.4	2.71E-12	3.50E-08	9.03E-12	1.17E-07	1.47E-11	6.48E-07	---	---	---	---	---	2.65E-11	7.99E-07
Organics Total Risk		2.71E-12	1.05E-07	9.03E-12	1.41E-07	1.47E-11	1.07E-06		NA	NA	NA	NA	2.65E-11	1.31E-06
TPH-GRO	2,096	NA	NA	NA	8.58E-06	NA	8.89E-05	650	NA	NA	NA	5.21E-04	NA	6.19E-04
TPH-DRO	390,375	NA	2.58E-03	NA	2.36E-03	NA	5.39E-03	250	NA	NA	NA	6.46E-03	NA	1.68E-02
TPH Total Risk		NA	2.58E-03	NA	2.36E-03	NA	5.48E-03		NA	NA	NA	6.98E-03	NA	1.74E-02
CUMULATIVE RISK		2.71E-12	2.58E-03	9.03E-12	2.36E-03	1.47E-11	5.48E-03		NA	NA	NA	6.98E-03	2.65E-11	1.74E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

TPH: Total petroleum hydrocarbon

GRO: Gasoline range organic

DRO: Diesel range organic

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

Table 10-8(b)
Calculation of Individual Excess Lifetime Cancer Risk (IELCR) and Hazard Quotient (HQ) for a Future Construction Worker
Area 9: Gun Range, Boeing Tract 1, St. Louis, Missouri

COCs	Average Soil Conc. (ug/kg)	Dermal Contact with Soil		Accidental Ingestion of Soil		Outdoor Inhalation of Vapors and Particulates from Soil		Average GW Conc. (ug/L)	Dermal Contact with Groundwater		Outdoor Inhalation of Vapors from Groundwater		Sum of IELCR	Sum of HQ (HI)
		IELCR	HQ	IELCR	HQ	IELCR	HQ		IELCR	HQ	IELCR	HQ		
Acetone	17	NA	1.73E-08	NA	6.01E-09	NA	1.03E-07	---	---	---	---	---	NA	1.26E-07
Methylene chloride	6.5	7.23E-13	1.12E-07	2.41E-13	3.75E-08	2.89E-12	1.07E-06	---	---	---	---	---	3.86E-12	1.22E-06
Naphthalene	110	NA	7.66E-07	NA	6.44E-07	NA	8.07E-08	---	---	---	---	---	NA	1.49E-06
Toluene	4.4	NA	5.75E-09	NA	1.92E-08	NA	3.48E-08	---	---	---	---	---	NA	5.97E-08
Organics Total Risk		7.23E-13	9.02E-07	2.41E-13	7.06E-07	2.89E-12	1.29E-06		NA	NA	NA	NA	3.86E-12	2.90E-06
TPH-GRO	500	NA	NA	NA	2.05E-06	NA	2.12E-05	500	NA	NA	NA	1.94E-04	NA	2.18E-04
TPH-DRO	2,520	NA	1.67E-05	NA	1.52E-05	NA	3.48E-05	121	NA	NA	NA	1.52E-03	NA	1.58E-03
TPH-ORO	3,148	NA	2.41E-05	NA	1.86E-05	NA	4.68E-06	311	NA	NA	NA	1.03E-02	NA	1.04E-02
TPH Total Risk		NA	4.07E-05	NA	3.58E-05	NA	6.07E-05		NA	NA	NA	1.20E-02	NA	1.22E-02
Arsenic	---	---	---	---	---	---	---	37	NA	NA	NA	NA	NA	NA
Cadmium	451	NA	1.57E-06	NA	1.57E-04	1.79E-11	3.97E-07	---	---	---	---	---	1.79E-11	1.59E-04
Copper	13,170	NA	1.15E-05	NA	1.15E-04	NA	2.03E-05	---	---	---	---	---	NA	1.47E-04
Manganese	611,550	NA	1.37E-04	NA	1.52E-03	NA	1.93E-02	1,750	NA	NA	NA	NA	NA	2.09E-02
Nickel	12,960	NA	1.13E-06	NA	2.26E-05	6.86E-11	1.00E-04	---	---	---	---	---	6.86E-11	1.24E-04
Selenium	2,412	NA	1.68E-05	NA	1.68E-04	NA	3.72E-04	---	---	---	---	---	NA	5.57E-04
Zinc	42,550	NA	4.95E-06	NA	4.95E-05	NA	6.25E-08	---	---	---	---	---	NA	5.45E-05
Metals Total Risk		NA	1.73E-04	NA	2.04E-03	8.65E-11	1.98E-02		NA	NA	NA	NA	8.65E-11	2.20E-02
CUMULATIVE RISK		7.23E-13	2.15E-04	2.41E-13	2.07E-03	8.94E-11	1.98E-02		NA	NA	NA	1.20E-02	9.03E-11	3.41E-02

Notes:

NA: Not available

---: Risk evaluation was not performed.

HI: Hazard index

ug/kg: Micrograms per kilogram

ug/L: Micrograms per liter

GRO: Gasoline range organic

DRO: Diesel range organic

ORO: Oil range organic

TPH: Total petroleum organic

APPENDIX F
CALCULATION OF GROUNDWATER TARGET CONCENTRATIONS

APPENDIX F

CALCULATION OF GROUNDWATER TARGET CONCENTRATIONS

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APPENDIX F CALCULATION OF GROUNDWATER TARGET CONCENTRATIONS

F.1 INTRODUCTIONS

This appendix presents the calculation of the groundwater target concentration for COCs with risk exceedances due to dermal contact with groundwater by a construction worker.

Per Table 2-1, the risks exceeded due to dermal contact with groundwater for the following sub-areas and COCs:

Sub-area	COCs	Exceedances	Risk Assessment
2B	PCE	Cumulative IELCR and Cumulative HI	RAM
6B	Benzo(a)anthracene	Total IELCR	RAM
	TCE	Cumulative HI	Tetra Tech
	Aroclor 1254	Cumulative IELCR	Tetra Tech

IELCR: Individual excess lifetime cancer risk

HI: Hazard index

The target concentration is a concentration of a COC in a specific media of concern at or below which the cumulative risk and/or total risk would not exceed the target risk (TR) levels. The following equation can be used to estimate the target concentration:

$$TC = \frac{RC \text{ or } EPC}{RRF} \quad (F-1)$$

$$RRF = \frac{CR}{TR} \quad (F-2)$$

where,

<i>TC</i>	=	Target concentration [µg/L]
<i>RC or EPC</i>	=	Representative concentration or exposure point concentration [µg/L]
<i>CR</i>	=	Calculated risk [-]
<i>TR</i>	=	Target risk level [-]
<i>RRF</i>	=	Risk reduction factor [-]

The term representative concentration (RC) was used by the RAM risk assessment. The term exposure point concentration (EPC) was used by the Tetra Tech risk assessment.

Each of the above input parameters is discussed below.

F.2 TARGET RISK LEVEL

To calculate the target concentrations, the following TR levels were used:

For carcinogenic health effects,

- Total IELCR for each chemical (sum of risk for all exposure pathways) of 1×10^{-5} , and
- Cumulative IELCR for each receptor (sum of risk for all chemicals and all exposure pathways) of 1×10^{-4} .

For non-carcinogenic health effects,

- Cumulative HI for each receptor (sum of HQ for all chemicals and all exposure pathways) of 1.0.

F.3 CALCULATED RISK

The following are the calculated risks for construction worker that exceeded the TR levels.

RAM Risk Assessment

Sub-area	COC	Total IELCR	Cumulative IELCR	Cumulative HI	Source
2B	PCE	N/A	3.35×10^{-4}	4.57	Table 3B-12(b) in Appendix C
6B	Benzo(a)anthracene	4.95×10^{-5}	N/A	N/A	Table 7B-10(b) in Appendix C

N/A: Not applicable since the risk did not exceed the TR levels.

Tetra Tech Risk Assessment

Sub-area	COC	Cumulative IELCR	Cumulative HI	Source
6B	TCE	N/A	112*	Table 7 in Tetra Tech, 2008 and RAM Group, 2010j
	Aroclor 1254	9×10^{-4}	N/A	Table 7 in Tetra Tech, 2008

N/A: Not applicable since the risk did not exceed the TR levels.

*: Sum of updated HI of 33 for TPHs (RAM Group, 2010j) and HI of 79 for risk driver chemicals (1,2-dichloroethene (total), benzene, trichloroethene, vinyl chloride, and mercury) (Tetra Tech, 2008)

F.4 RISK REDUCTION FACTOR

The RRFs were calculated for carcinogenic and non-carcinogenic effects using Equation (F-2), TR levels in Section F.2, and RC/EPC in Section F.3. For PCE in Sub-area 2B whose risk exceeded by both carcinogenic and non-carcinogenic TR levels, conservatively the higher value of two RRFs was used in the calculation. Therefore, the smaller target concentration value was

calculated.

The following are the calculated RRFs.

Sub-area	COC	Carcinogenic			Non-carcinogenic			RRF
		CR	TR	RRF	CR	TR	RRF	
2B	PCE	3.35×10^{-4}	1×10^{-4}	3.35	4.57	1	4.57	4.57
6B	Benzo(a)anthracene	4.95×10^{-5}	1×10^{-5}	4.95	N/A	N/A	N/A	4.95
	TCE	N/A	N/A	N/A	112	1	112	112
	Aroclor 1254	9×10^{-4}	1×10^{-4}	9	N/A	N/A	N/A	9

N/A: Not applicable

F.5 REPRESENTATIVE CONCENTRATION OR EXPOSURE POINT CONCENTRATION

The following are the RC or EPC used for the risks shown in Section F.3:

Sub-area	COC	RC/EPC [µg/L]	Source
2B	PCE	19,115	Table 3B-12(b) in Appendix C
6B	Benzo(a)anthracene	126	Table 7B-10(b) in Appendix C
	TCE	1,400	Table 7 in Tetra Tech, 2008
	Aroclor 1254	580	Table 7 in Tetra Tech, 2008

Note: COCs in bold font by the RAM risk assessment and COCs in regular font by the Tetra Tech risk assessment

F.6 TARGET CONCENTRATION

Using Equation (F-1) and RRFs in Section F.5, target concentrations have been calculated as shown below:

Sub-area	COC	RC/EPC [µg/L]	RRF [--]	TC [µg/L]
2B	PCE	19,115	4.57	4,183
6B	Benzo(a)anthracene	126	4.95	26
	TCE	1,400	112	13
	Aroclor 1254	580	9	64

These target concentrations are also referred in Section 3.0.

APPENDIX G
BOEING PERMITTED FACILITY EXCAVATED SOIL MANAGEMENT PLAN

**BOEING PERMITTED FACILITY
EXCAVATED SOIL MANAGEMENT PLAN**

January 2011

Boeing Defense, Space & Security – St. Louis
Environment, Health and Safety

BOEING PERMITTED FACILITY EXCAVATED SOIL MANAGEMENT PLAN

I. Purpose/Summary

The overall objective of the Soil Management Plan (the "Plan") is to assure the continued protection of human health and the environment during current and future operations at the Boeing Permitted Facility. This Plan outlines the process and responsibilities associated with any development related disturbance of contaminated soil located on property subject to the jurisdiction of the current Missouri Hazardous Waste Management Facility (MHWMF) Part I Permit issued to Boeing as both owner and operator. This includes portions of the Boeing Tract I South permitted property now owned by the City of St. Louis, the Tract I North property now owned by GKN Technologies, and the buildings in both of these Tracts where Boeing still remains the owner of the property. The responsibilities described in this Plan apply to all development related activities at the permitted properties, including such activities conducted or initiated by any tenants or lessees of the parties hereto. This Plan outlines the planning, management and disposal procedures for contaminated soil that may be encountered during construction and maintenance activities, conducted on portions of the permitted property.

Specific responsibilities associated with any disturbance of soil by the owners of the property subject to the current permit may vary. To address each of the situations, Boeing, GKN and the City of St. Louis will be addressed in a section specific to the respective property ownership. Nothing in this document shall alter the various agreements between and among Boeing, MDC, GKN and the City of St. Louis regarding the allocation of costs for implementation of this Plan.

Upon final approval of a site-wide Corrective Measures Study by the Missouri Department of Natural Resources, this Plan may be modified to conform to the corrective measures implemented for the property.

II. General Requirements – Boeing Property

1. McDonnell Douglas Corporation (MDC) – St. Louis, a wholly-owned subsidiary of The Boeing Company, is responsible for all soil management associated with soil disturbance activities on portions of the permitted property owned by Boeing (see Property Ownership Map. Appendix A). Soil management as discussed in this section may include pre-project investigation, evaluation and documentation, sample collection and analysis, associated labor and equipment for excavation, transportation and disposal of soil.
2. GKN will be responsible for all soil management associated with soil disturbance activities on portions of the permitted property owned by GKN.

3. The City of St. Louis, owner and operator of Lambert-St. Louis International Airport® (the "City") will be responsible for all soil management associated with development related soil disturbance activities on portions of the permitted property owned by the City.
4. Boeing Environment, Health and Safety (EHS) will provide environmental project oversight for all soil disturbance activities covered by this Plan conducted on that portion of the permitted property owned by Boeing.
5. Prior to beginning any soil disturbance activities on permitted property now owned by Boeing, EHS will obtain the following information:
 - a) Description of construction or maintenance activities that are being planned;
 - b) Date project is to begin;
 - c) Specific location of soil disturbance or soil excavation;
 - d) Anticipated volume of soil that will be disturbed/excavated;
 - e) Requirements for backfill and final finishing of excavation;
 - f) Identification of any environmental contractors that will be used to perform any work;
 - g) Identification of any land disturbance or stormwater management permits that may be required;
 - h) Identification of any issues associated with the location of utility lines.
6. After a review of all of the project information on permitted property now owned by Boeing, a determination will be made by EHS as to the potential impact of the project with respect to areas with documented subsurface contamination.
 - a) If it is determined that the project is not expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided instructions should contamination be discovered during the project.
 - b) If it is determined that the project is expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided with specific information related to the location, depth(s) and level of contaminants. Boeing EHS will review the construction plans to determine if there is any feasible way to relocate the construction work to an area that is free of documented contamination.
 - (1) If construction relocation proves infeasible:
 - (a) Boeing will meet with all involved to discuss specific details and plans related to construction in areas of known contamination, including the following:
 - 1) Detailed information about the contamination;

- 2) Personal protective equipment needs/use and personnel training requirements and/or HAZWOPER qualifications;
 - 3) Equipment decontamination procedures;
 - 4) Soil management procedures;
 - 5) Groundwater management procedures;
 - 6) Stormwater management procedures;
 - 7) Excavation zone limits;
 - 8) Potential creation of preferential groundwater flow pathways (granular backfill, trenches, etc.);
 - 9) Any engineering controls;
 - 10) Additional details as needed.
- (b) Temporary containment areas may need to be constructed related to staging/loading of soil. These areas should be relatively close to the point of generation. Soil must be placed on an engineered surface (concrete or plastic liner). A berm, at least six inches in height, must surround the surface to contain any runoff. Any additional measures identified in the Land Disturbance Permit (if applicable) must be addressed.
- (c) Backfilling of the excavation will be performed to ensure that contamination is not spread through the creation of preferential groundwater flow pathways (granular backfill, trenches, etc.).
- (d) The type of loading and hauling equipment used for the project will be determined by Boeing. Operations to control Foreign Object Damage (FOD) and dust at the job site must be conducted at regular intervals.
- (e) Disposal facility and waste permitting requirements must be addressed as early in the process as possible.
- (f) Hazardous Waste Management Facility Permit Corrective Action Conditions II. A. and III. A. require Boeing to notify MDNR and EPA within 15 days of the discovery of new Solid Waste Management Units (SWMUs), Areas of Concern (AOC), or newly-identified releases from previously identified SWMUs/AOC. Any information related to the foregoing discoveries/situations must be immediately communicated to Boeing EHS. Notification of discovery of situations that may require stabilization action(s) are also required by the MHWMF Part I permit. Any information related to the foregoing discoveries/situations must be immediately communicated to Boeing EHS. Boeing will notify the Missouri Department of Natural Resources (MDNR) and EPA, as appropriate.
- (g) Any pre- or post-excavation sampling should be proposed in a plan for MDNR approval prior to implementation, except in the case of

emergencies. Post-excavation sampling of the floor and/or walls of an excavation will only occur in circumstances where additional soil characterization is necessary, or where post-excavation removal verification for soils shipped off-site is necessary.

III. General Requirements – GKN Property

1. GKN is responsible for all soil management associated with soil disturbance activities on portions of the permitted property owned by GKN (see Property Ownership Map. Appendix A). Soil management as discussed in this section may include pre-project investigation, evaluation and documentation, sample collection and analysis, associated labor and equipment for excavation, transportation and disposal of soil.
2. Boeing will be responsible for all soil management associated with soil disturbance activities on portions of the permitted property owned by Boeing (See Appendix A)
3. The City will be responsible for all soil management associated with development related soil disturbance activities on portions of the permitted property owned by the City.
4. GKN Environmental Safety and Health (ESH) will provide environmental project oversight for all soil disturbance activities covered by this Plan conducted on that portion of the permitted property owned by GKN.
5. Prior to beginning any soil disturbance activities on permitted property now owned by GKN, GKN Safety will obtain the following information:
 - a) Description of construction or maintenance activities that are being planned;
 - b) Date project is to begin;
 - c) Specific location of soil disturbance or soil excavation;
 - d) Anticipated volume of soil that will be disturbed/excavated;
 - e) Requirements for backfill and final finishing of excavation;
 - f) Identification of any environmental contractors that will be used to perform any work;
 - g) Identification of any land disturbance or stormwater management permits that may be required;
 - h) Identification of any issues associated with the location of utility lines.
6. After a review of all of the project information, a determination will be made by GKN as to the potential impact of the project with respect to areas with documented subsurface contamination.
 - a) If it is determined that the project is not expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided instructions should contamination be discovered during the project.

- b) If it is determined that the project is expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided with specific information related to the location, depth(s) and level of contaminants. GKN will review the construction plans to determine if there is any feasible way to relocate the construction work to an area that is free of documented contamination.

(1) If construction relocation proves infeasible:

- (a) Boeing will meet with all involved to discuss specific details and plans related to construction in areas of known contamination, including the following:

- 1) Detailed information about the contamination;
- 2) Personal protective equipment needs/use and personnel training requirements and/or HAZWOPER qualifications;
- 3) Equipment decontamination procedures;
- 4) Soil management procedures;
- 5) Groundwater management procedures;
- 6) Stormwater management procedures;
- 7) Excavation zone limits;
- 8) Potential creation of preferential groundwater flow pathways (granular backfill, trenches, etc.);
- 9) Any engineering controls;
- 10) Additional details as needed.

- (b) Temporary containment areas may need to be constructed related to staging/loading of soil. These areas should be relatively close to the point of generation. GKN has a designated area that is used to stage stock-piled soil requiring additional analysis located on the east section of the GKN property.

- (c) Backfilling of the excavation will be performed to ensure that contamination is not spread through the creation of preferential groundwater flow pathways (granular backfill, trenches, etc.).

- (d) The type of loading and hauling equipment used for the project will be determined by GKN. Operations to control Foreign Object Damage (FOD) and dust at the job site must be conducted at regular intervals.

- (e) Disposal facility and waste permitting requirements must be addressed as early in the process as possible.

- (f) Hazardous Waste Management Facility Permit Corrective Action Conditions II. A. and III. A. require Boeing to notify MDNR and EPA

within 15 days of the discovery of new Solid Waste Management Units (SWMUs), Areas of Concern (AOC), or newly-identified releases from previously identified SWMUs/AOC. Any information related to the foregoing discoveries/situations must be immediately communicated to Boeing EHS. Notification of discovery of situations that may require stabilization action(s) are also required by the MHWMF Part I permit. Any information related to the foregoing discoveries/situations must be immediately communicated to Boeing EHS. Boeing will notify the Missouri Department of Natural Resources (MDNR) and EPA, as appropriate.

- (g) Any pre- or post-excavation sampling should be proposed in a plan for MDNR approval prior to implementation, except in the case of emergencies. Post-excavation sampling of the floor and/or walls of an excavation will only occur in circumstances where additional soil characterization is necessary, or where post-excavation removal verification for soils shipped off-site is necessary.

IV. General Requirements – City Property

1. The City and MDC have signed a Site Management and Redevelopment Agreement dated August 15, 2006 associated with soil management activities on portions of the permitted property owned by the City (the "Redevelopment Agreement"). This Plan addresses pre-project investigation, evaluation and documentation, sample collection and analysis, associated labor and equipment for excavation, transportation and disposal of contaminated soil. For purposes of this Plan, "contaminated" soils are soils which exceed the MRBCA Default Target Levels. This Plan between the City and Boeing specifically addresses the responsibilities of both parties related to responsibilities for contaminated soil management. As among Boeing, MDC and the City, nothing in this Plan is intended to alter or conflict with the Redevelopment Agreement. To the extent that anything in this Plan is inconsistent with the Redevelopment Agreement, the Redevelopment Agreement shall prevail.
2. Boeing and GKN will be responsible for all soil management associated with soil disturbance activities on portions of the permitted property not owned by the City.
3. The City will provide environmental project planning and oversight for all redevelopment activities which result in soil disturbance covered by this Plan conducted on that portion of the permitted property now owned by the City.
4. Prior to redevelopment activities on permitted property now owned by the City, the Airport Environmental Manager must be contacted by any construction contractor or group performing work that will disturb soil.

5. The construction contractor or group performing the work that will disturb soil shall provide the information listed below to the Airport Environmental Manager. In the event of an emergency, this information must be provided in a reasonable amount of time with as much information as available.
 - a) Description of construction or maintenance activities that are being planned;
 - b) Date project is to begin;
 - c) Specific location of soil disturbance or soil excavation;
 - d) Anticipated volume of soil that will be disturbed/excavated;
 - e) Requirements for backfill and final finishing of excavation;
 - f) Identification of any environmental contractors that will be used to perform any work;
 - g) Identification of any land disturbance or stormwater management permits that may be required;
 - h) Identification of any issues associated with the location of utility lines.
6. The Airport Environmental Project Manager will review all of the information received from the construction contractor or group, comparing this information with existing site characterization information found in the documents listed in Appendix B, which will be periodically updated to reflect interim corrective measures and final corrective measures approved by MDNR.
7. After a review of all of the project information, a determination will be made by the Airport Environmental Manager as to the potential impact of the project with respect to areas that are documented to be contaminated.
 - a) If it is determined that pre-job sampling will be performed by the City, the City will provide copies of the Pre-job Sampling Plan to Boeing. If Boeing has any comments on the plan, Boeing will provide comments to such plans for consideration within fifteen (15) calendar days.
 - b) If it is determined that the project is not expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided instructions to follow should contamination be discovered during the project.
 - c) If it is determined that the project is expected to encounter subsurface contamination, the construction contractor or group performing the work will be provided with specific information related to the location, depth(s) and level of contaminants. Reasonable steps shall be taken to avoid and minimize disturbance of the subsurface contamination.
 - (1) The Airport Environmental Manager and the construction contractor or group performing the work will meet to discuss specific details and plans

related to construction in areas of known contamination including the following:

- a) Detailed information about the contamination;
- b) Personal protective equipment needs/use and personnel training requirements and/or HAZWOPER qualifications;
- c) Equipment decontamination procedures;
- d) Soil management procedures;
- e) Groundwater management procedures;
- f) Stormwater management procedures;
- g) Excavation zone limits;
- h) Potential creation of preferential groundwater flow pathways (granular backfill, trenches, etc.);
- i) Any engineering controls;
- j) Additional details as needed.

8. During the preliminary activities and planning for the project, the City will determine if the potential exists for the excavated contaminated soil to be returned to the original excavation or used elsewhere on the permitted property. To minimize soil handling and disposal requirements, excavated contaminated soil should be reused onsite as fill or backfill whenever feasible, so long as that reuse is protective of human health and the environment.

- a) The management of any excavated soil shall be in accordance with Appendix C, Summary of Designated Categories of Fill Material and Constituent Criterion.
- b) If the Airport Environmental Manager determines that the contaminated soil is anticipated to be re-used on site, the following steps will be followed:
 - (1) The Airport Environmental Manager will identify the location for temporary management and replacement of the excavated contaminated soil. In most cases, soil is expected to be returned to the location from which it was excavated.
 - (2) If the contaminated soil is to be reused in a location other than the original excavation, the specific location must be identified by the Airport Environmental Manager. The following general criteria are applicable when contaminated soil will be placed in a location other than the original excavation:
 - (a) Location must be on the permitted property and not accessible by the general public, and
 - (b) The soil must contain no visible free liquids (e.g., groundwater) and must be sufficiently dry so as to not produce free liquids following placement, and

- (c) The location of the soil placement must be documented with the Airport Environmental Management Office if on property owned by the City, and shall also be provided to MDNR for placement in facility file.
 - (d) The location of the soil placement must be consistent with any and all of the activity and use limitations placed on the permitted property.
 - (3) Analytical data is required to support any contaminated soil reuse onsite. This data may come from existing corrective action identified in Appendix B, and/or from any additional pre or post excavation soil sampling and analysis. The Pre-job Sampling Plan must be submitted to MDNR as provided in Article V of this Plan identifying specific constituents and specific analytical parameters, including information on the purpose and use of the data related to soil reuse.
 - (4) Reuse of contaminated soil onsite is allowed only with written approval of the Pre-job Sampling Plan by MDNR as provided in Article V of this Plan, indicating all regulatory requirements have been addressed. Unless otherwise approved by MDNR, contaminated soil reused onsite must be free of debris and piping, and the reused contaminated soil is placed at a minimum of one (1) foot below surface. Contaminated soil reused onsite must not be used as finishing grade. Adequate controls must be in place to ensure soil reuse does not create additional contamination issues at the proposed reuse location (as determined by the Airport Environmental Manager). In addition, significant amounts of groundwater must not be transferred into the reuse area. Soil meeting these criteria will be placed in specific location identified in the Pre-job Sampling Plan approved by the department as provided in Article V of this Plan.
 - (5) The Airport Environmental Manager will maintain information of all contaminated soil management activities on portions of the permitted property owned by the City. This information will contain locations of contaminated soil reused onsite, locations of soil removed for disposal, and analytical data collected during soil management activities.
- c) If it is determined by the City during the preliminary activities and planning for the project that the contaminated soil will NOT be reused on site:
- (1) Soil samples will be collected and analyzed for contaminated soil disposal. The location, quantity and type of soil sample to be collected must be determined. The Pre-job Sampling Plan for collection of soil samples for disposal must include the objective and or purpose of this sampling (i.e., determining excavation limits/requirement, personal protective equipment requirements, etc.).

- (2) The following issues must be addressed by the Airport Environmental Manager in coordination with the construction contractor or the group performing the work.
- (e) Groundwater must be managed to ensure any contamination is not spread to uncontaminated areas. This may involve collection, treatment and proper disposal of contaminated groundwater.
 - (f) Specific actions must be discussed should debris or piping be encountered during the soil disturbance or excavation.
 - (g) Should asbestos-containing piping be encountered in the excavation, work will be stopped and an asbestos abatement contractor called to complete the operation.
 - (h) The Airport Environmental Manager will be notified for specific direction if any debris is encountered in an excavation. Any liquid associated with piping debris must be specifically addressed.
 - (i) Temporary containment areas may need to be constructed related to staging/loading of contaminated soil. These areas should be relatively close to the point of generation. Contaminated soil must be placed on an engineered surface (concrete or plastic liner). A berm at least six inches in height must surround the surface to contain any runoff.
 - (j) Backfilling of the excavation will be performed ensuring that contamination is not spread through the creation of preferential groundwater flow pathways (granular backfill, trenches, etc.)
 - (k) The type of loading and hauling equipment used for the project will be determined by the Airport Environmental Manager. Operations to control Foreign Object Damage (FOD) and dust at the job site must be conducted at regular intervals.
- (3) Disposal of non-hazardous special waste soil will be addressed by the City. This may include obtaining special waste disposal approval from MDNR and St. Louis County Health Department.
- (4) Waste soil that is determined to be hazardous waste will be managed by the City, except that waste soil determined to originate from Boeing's historical operations will be shipped off-site for disposal at a Boeing approved waste disposal facility under the U.S. EPA and MDNR ID number assigned to Boeing for the site. Any off-site shipments utilizing the Boeing ID number will be reviewed by Boeing prior to shipment, with Boeing responsible for waste profiling, manifesting, and regulatory reporting associated with such shipments.

9. Hazardous Waste Management Facility Permit Corrective Action Conditions II.A. and III.A. require Boeing to notify MDNR and EPA within 15 days of the discovery of new Solid Waste Management Units (SWMUs), Areas of Concern, (AOC) or newly-identified releases from previously identified SWMUs/AOC. Notification of discovery of situations that may require stabilization action(s) are also required by the MHWMF Part I permit. The discovery of any new Solid Waste Management Units (SWMUs), Areas of Concern, (AOC) or newly-identified releases from previously identified SWMUs/AOC, or the discovery of situations that may require stabilization action(s) must be communicated by the City to Boeing as soon as practicable. Boeing will notify the department and EPA, as appropriate.

V. MDNR Review and Approval

1. MDNR generally expects to review and approve a pre-job plan before redevelopment soil disturbance activities for "planned" construction but not for "emergency" repairs that involve disturbing contaminated soils within the permitted property. In the case of emergencies, after the fact reporting would be expected.
2. If redevelopment construction occurs on the permitted property owned by the City, the Redevelopment Agreement between MDC and the City specifies who is responsible for reimbursement of the Department's oversight costs.
3. To facilitate site redevelopment and repair/maintenance of utilities on site that may be in a contaminated area of the permitted property, this Soil Management Plan must be followed.
4. A plan view map, which is legible and clear, showing the following shall be submitted to the Department before soil disturbance activities for planned construction activities which will disturb contaminated soils commence:
 - a) Location(s) and depth(s) of the necessary repair,
 - b) Location(s) and depth(s) of any pre-job samples, and
 - c) The location(s) of any known hazardous waste site (regulated units) or Solid Waste Management Units (SWMU's) and/or releases from such units which could be impacted by the proposed excavation/construction activities, and
 - d) Any information relevant to disturbance of areas with known contamination.
5. Pre-job soil sampling/analysis and subsequent excavation activities on the permitted property could lead to the discovery of additional SWMUs/ AOC's. Any SWMUs/AOCs and/or new releases from known SWMUs/AOCs discovered by Boeing, or reported to Boeing by GKN or City, must be reported to the Department and EPA by Boeing in accordance with Special Permit Conditions V

and VI as applicable. The Department acknowledges that Boeing's knowledge of additional SWMUs/AOC's and/or new releases from known SWMUs/AOCs located on permitted property owned or operated by GKN or City, and obligation to report such information to the Department and EPA, is limited to such information as is provided by GKN or City.

6. When contaminated soil is approved for backfill into the excavation, a clean layer of soil must be placed at grade on top of the soil that is backfilled. The clean soil layer shall be a minimum of one (1) foot thick and be free of contamination above MRBCA DTLs levels. Any contaminated soil which is not used as backfill must be managed and disposed of in accordance with all applicable local, state, and federal requirements.
7. The Soil Management Plan requests must be submitted (electronically when possible) to the MDNR at least 15 working days prior to performing the work. When possible, requests should be grouped together and consolidated. The Project Manager will confirm MDNR's receipt of the request. Within 10 working days, MDNR will notify requestor Project Manager by phone or e-mail if the request is approved or if MDNR has questions. If MDNR's approval is verbal, that approval will be confirmed by letter or e-mail within 5 working days. If approval is not received within 10 working days the project manager will contact MDNR to resolve any issues related to the request and obtain approval within the remaining 5 working days of the verbal approval.
8. Nothing contained herein shall be construed as preventing or otherwise limiting the Project Manager's ability to respond to an emergency situation or condition (e.g.: water, sewer or gas line break) that requires disturbance of contaminated soil. Following mitigation of an emergency, the Project Manager shall contact the Department as soon as practicable to advise that contaminated soil has been disturbed and to receive further instructions as to what additional action, if any and reporting will be required to address final disposition of the contaminated soil.

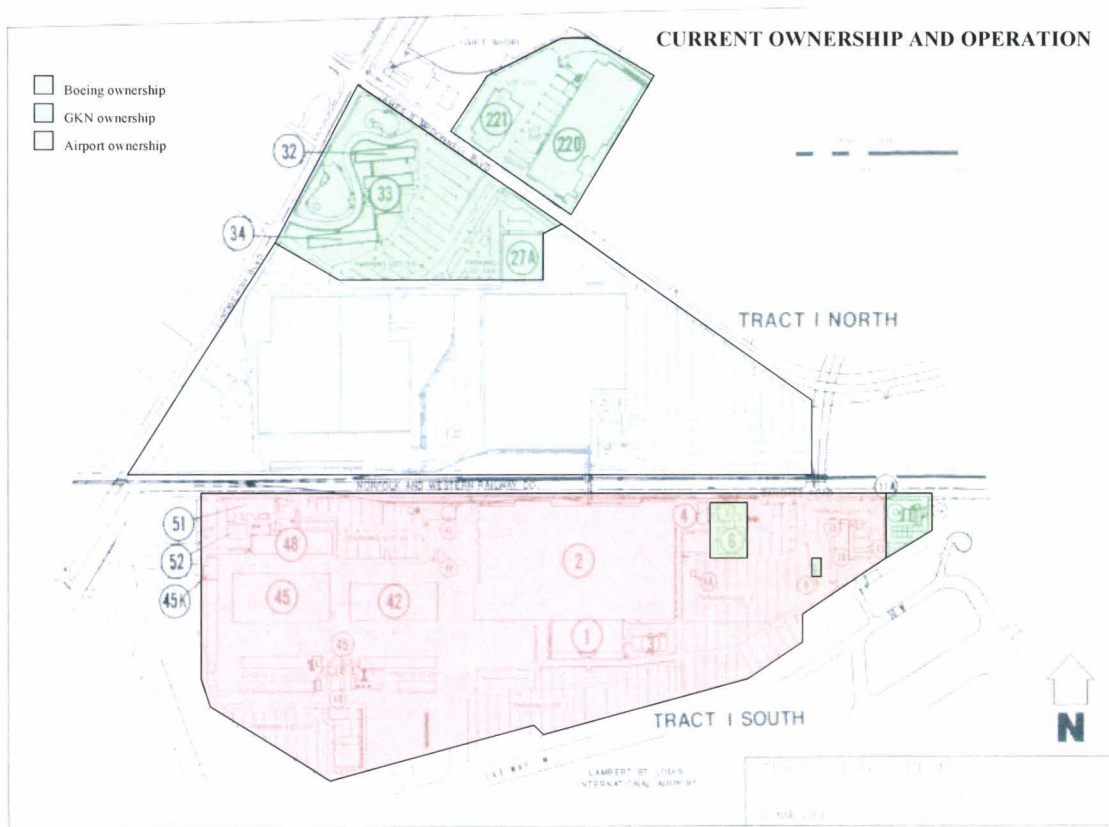
Signature Page

BOEING	
Signature	
Title	
Date	

CITY of ST. LOUIS	
Signature	
Title	
Date	

GKN	
Signature	
Title	
Date	

Appendix A Property Ownership Map



Appendix B

Corrective Action Administrative Records

	Author	Title
5/29/1997	Environmental Science & Engineering, Inc., St. Louis, MO	RCRA Facility Investigation Workplan for McDonnell Douglas, Hazelwood, Missouri Facility, Volume I
12/18/1997	Heritage Environmental Services, Inc., Chicago, IL	Interim Measures Completion Report, McDonnell Douglas Aerospace, U.S. EPA ID No. MOD000818963, Tract I Facility, Hazelwood, Missouri
4/20/2001	Harding ESE, Inc., St. Louis, MO	RCRA Facility Investigation Workplan Addendum II for McDonnell Douglas, Hazelwood, Missouri
7/19/2001	Harding ESE, Inc., St. Louis, MO	RCRA Facility Investigation Workplan Addendum II for McDonnell Douglas, Hazelwood, Missouri
9/27/2002	Harding ESE, Inc., St. Louis, MO	Environmental Field Investigation Statement of Work for Boeing Tract I South Property, Hazelwood, Missouri
10/29/2002	Harding ESE, Inc., St. Louis, MO	Annual monitoring Report for Solid Waste management Unit 17, McDonnell Douglas, Hazelwood, Missouri
3/2003	Golder Associates, Inc., St. Charles, MO	Environmental Baseline Survey, Boeing Tract I South Facility, Hazelwood, MO
11/7/2003	MACTEC Engineering and Consulting, Inc., St. Louis, MO	Environmental Investigation Report for Boeing Tract I South Property
2/3/2004	MACTEC Engineering and Consulting, Inc., St. Louis, MO	Enhanced Bioremediation Pilot Test Report for Boeing Tract I, Hazelwood, Missouri
9/2004	Risk Assessment & Management Group, Inc., Houston, TX	Risk Based Corrective Action Report, Boeing Tract I, St. Louis, Missouri
12/2004	MACTEC Engineering and Consulting, Inc., St. Louis, MO	RCRA Facility Investigation Report for McDonnell Douglas, Hazelwood, Missouri
10/20/05	MACTEC Engineering and Consulting, Inc., St. Louis, MO	Interim Action Remedial Excavation Workplan, Solid Waste Management Unit 17, McDonnell Douglas, Hazelwood, Missouri
12/5/05	MACTEC Engineering and Consulting, Inc., St. Louis, MO	TPH Soil Vapor Sampling Workplan, Boeing Tract I, Hazelwood, Missouri

5/2006	MACTEC Engineering and Consulting, Inc., St. Louis, MO	Interim Action Remediation Excavation Completion Report, Boeing Tract I, McDonnell Douglas, Hazelwood, Missouri
6/2006	MACTEC Engineering and Consulting, Inc., St. Louis, MO	Interim Action Remedial Excavation Completion Report, Solid Waste Management Unit 17, McDonnell Douglas, Hazelwood, Missouri
3/2008	Tetra Tech EM, Inc., Lenexa, KS	Final Risk Assessment, Boeing Tract I Facility, St. Louis, Missouri
4/7/2010	RAM Group of Gannett Fleming, Inc., Houston, TX	Quality Assurance Plan, Boeing Tract 1, Hazelwood, Missouri
4/21/2010	RAM Group of Gannett Fleming, Inc., Houston, TX	Final Corrective measures Study Work Plan, The Boeing Company Tract 1, Hazelwood, Missouri
6/8/2010	RAM Group of Gannett Fleming, Inc., Houston, TX	Ground Water Gauging and Sampling-Spring 2010, Boeing Tract 1, Hazelwood, Missouri
12/2010	RAM Group of Gannett Fleming, Inc., Houston, TX	Ground Water Gauging and Sampling-Fall 2010, Boeing Tract 1, Hazelwood, Missouri

Appendix C

Summary of Designated Categories of Fill Materials and Constituent Criterion.

Category	Allowable Contaminant Limits	Allowable Uses/Requirements
Clean Fill*	Clean fill applies to soil, sand, gravel and rock where the concentration of <u>all</u> Constituents of Concern (COCs) are below their respective MRBCA Table B-1 DTLs or are below background levels.	Materials that qualify as "clean fill" do not require blanket beneficial use or site-specific approval and may be used without restriction in residential and non-residential applications. MDNR Water Protection Program approval may be required if placed in contact with surface water or groundwater. Subject to any applicable local approval requirements.
Blanket Beneficial Use Approval**	Blanket beneficial use applies to soil, sand, gravel and rock where the concentration of <u>any</u> COC is greater than its respective MRBCA Table B-1 DTL but <u>all</u> COCs are less than their respective MRBCA Table B-3 Risk-Based Target Levels for Residential Land Use Type 2 (Silty) Soil or below background. Materials containing <u>any</u> COC concentration greater than its respective MRBCA Table B-3 level are <u>not</u> approved for blanket beneficial use. Submission of a site-specific beneficial use request is required for materials with <u>any</u> COC concentration greater than its respective MRBCA Table B-3 level.	Materials that qualify for blanket beneficial use may be used, without additional site-specific approval, provided the material contains COC concentrations within allowable limits and the materials are placed on property subject to the jurisdiction of the Missouri Hazardous Waste Management Facility Permit. Transportation and placement of blanket beneficial use materials must be conducted in a manner that protects human health, worker safety and the environment

<p>Site Specific Beneficial Use***</p>	<p>Site-specific beneficial use applies to soil, sand, gravel and rock where the concentration of <u>any</u> COC is greater than its respective MRBCA Table B-3 Risk-Based Target Level for Residential Land Use Type 2 (Silty) Soil but <u>all</u> COCs are less than their respective MRBCA Table B-6 Risk-Based Target Levels for Non-residential Land Use Type 2 (Silty) Soil</p> <p>Site-specific beneficial uses for the subject materials cannot be granted where <u>any</u> COC concentration is greater than its respective Table B-6 Risk-Based Target Level for Non-residential Land Use Type 2 (Silty Soil Type) or where these materials exhibit the characteristic of toxicity via Toxicity Characteristic Leaching Procedure (TCLP) testing.</p>	<p>Site-specific beneficial use of soil requires prior review and written approval by the department. The department shall be consulted as to applicable requirements for approval of site-specific beneficial use at the time any such use is proposed.</p> <p>Site-specific beneficial use will be limited to property subject to the jurisdiction of the Missouri Hazardous Waste Management Facility Permit and may require implementation of land use restrictions or other exposure controls in areas where site-specific beneficial use is approved.</p>
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- * See MRBCA Table B-1 - Lowest Default Target Levels All Soil Types and Pathways. Guidance for determining background COC concentrations may be found in MRBCA Appendix M.
- ** See MRBCA Table B-3 – Tier 1 Risk Based Target Levels Residential Land Use Soil Type 2 (silty soil type).
- *** See MRBCA Table B-6.

APPENDIX H
UST CLOSURE APPROVAL LETTERS FROM MDNR

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Bob Holden, Governor • Stephen M. Matlock, Director

DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

Mr. Elmer Dwyer
The Boeing Company
P.O. Box 516 MC S111-1099
St. Louis, MO 63166-0516

RE: Site #3, Tract 1, Building 45, Lindbergh Blvd., Dept. C, St. Louis, St. Louis County, MO
ST5700283, R0002516

Dear Mr. Dwyer:

The Missouri Department of Natural Resources' Hazardous Waste Program, Tanks Section, has received and reviewed a response letter dated January 28, 2002, submitted by The Boeing Company, for the above referenced site.

The laboratory analytical results of the groundwater samples collected from monitoring MW#A1, MW#A3, and MW#3A indicate the presence of petroleum hydrocarbon contamination at concentrations below the department's cleanup levels.

Therefore, based on a review of the analytical data and other information submitted, the department finds that no additional investigation or remedial action is currently required with regard to petroleum hydrocarbon spill/release. However, the department's finding is based solely on the information contained in these reports, and this finding does not constitute a certification or guarantee of the quality of the remedial action conducted or with regard to the lack of contamination on the property.

In the event a future petroleum hydrocarbon related environmental problem arises in the vicinity of this property, the department expressly reserves the right to require responsible parties to conduct additional investigation and/or remedial actions.

The monitoring wells must be properly closed and abandoned in accordance with the department's regulations. You may contact the department's Geological Survey and Resource Assessment Division for information regarding proper well closure.

Mr. Elmer Dwyer
Page 2

Please direct questions regarding the Petroleum Storage Tank Insurance Fund to the Fund Administrator at (573) 761-4060 or (800) 765-2765.

If you have any questions regarding this letter, you may contact the project manager for this site, Mr. Matt Alhalabi of my staff at (573) 751-6822.

Sincerely,

HAZARDOUS WASTE PROGRAM



Frederick J. Hutson, R.G., Chief
Remediation Unit

FJH:mak

c: Mr. Neil Elfrink, Geological Survey and Resource Assessment Division
Mr. David Pate, Petroleum Storage Tank Insurance Fund
Mr. Mike Struckhoff, St. Louis Regional Office

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

Mr. Joseph Haake
Environmental and Hazardous Materials Services
The Boeing Company
Dept. 464C, Building 220
Mailcode S221-1400
P.O. Box 516
St. Louis, MO 63166

RE: McDonnell Douglas Site #4, Banshee Rd., Bldg. 45, St. Louis, St. Louis County, MO
ST5700085, R0002477

Dear Mr. Haake:

The Missouri Department of Natural Resources' Hazardous Waste Program, Tanks Section, received and reviewed a groundwater monitoring report dated May 10, 2002, submitted by The Boeing Company, for the above referenced site.

The report documents the laboratory results of the groundwater samples collected during April 2002. The laboratory results indicate petroleum hydrocarbon contamination is below the department's cleanup levels.

Based on a review of the analytical data and other information submitted, the department finds that no additional investigation or remedial action is currently required with regard to petroleum hydrocarbon spill/release. However, the department's finding is based solely on the information contained in these reports, and this finding does not constitute a certification or guarantee of the quality of the remedial action conducted or with regard to the lack of contamination on the property.

In the event a future petroleum hydrocarbon related environmental problem arises in the vicinity of this property, the department expressly reserves the right to require responsible parties to conduct additional investigation and/or remedial actions.

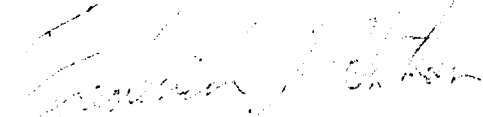
Please direct questions regarding the Petroleum Storage Tank Insurance Fund to the Fund Administrator at (573) 761-4060 or (800) 765-2765.

Mr. Joseph Haake
Page 2

If you have any questions, please contact the project manager for this site, Mr. Matt Alhalabi at (573) 751-6822.

Sincerely,

HAZARDOUS WASTE PROGRAM



Frederick J. Hutson, R.G., Chief
Remediation Unit

FJH:maj

c: Mr. David Pate, Petroleum Storage Tank Insurance Fund
Mr. Mike Struckhoff, St. Louis Regional Office

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Mid-Continent Governor • Stephen M. Mahford, Director

DIVISION OF ENVIRONMENTAL QUALITY

P.O. Box 176 Jefferson City, MO 65102-0176

February 23, 1999

Mr. Elmer Dwyer
Boeing Company
P.O. Box 516 MC S111-1099
St. Louis, MO 63166-0516

RE: McDonnell Douglas Site #1, Lambert Building #45-K, Bridgeton, MO - R0002517

Dear Mr. Dwyer:

The Tanks Section of the Hazardous Waste Program has received and reviewed the January 12, 1999, Soil Investigation Report for the site listed above.

Based upon a review of the analytical data and other information submitted, the department finds that no additional investigation or remedial action is currently required with regard to these petroleum substances. However, the department's finding is based solely on the information contained in these reports, and this finding does not constitute a certification or guarantee of the quality of the remedial action conducted or with regard to the lack of contamination on the property.

In the event a future petroleum-related environmental problem arises in the vicinity of this property, the department reserves the right to require responsible parties to conduct additional investigation and/or remedial actions.

If you have any questions regarding this letter, you may contact Ms. Julie Pearson of my staff at (573) 751-6822.

Sincerely,

HAZARDOUS WASTE PROGRAM


Jim Growney, Chief
Remediation Unit

JG:jpe

c: Mr. David Pate, Williams and Company
St. Louis Regional Office

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Bob Holden, Governor • Stephen M. Mahfood, Director

DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

Mr. Joseph Haake
Environmental and Hazardous Materials Services
The Boeing Company
Dept. 464C, Building 220
Mailcode S221-1400
P.O. Box 516
St. Louis, MO 63166

RE: McDonnell Aircraft, Tract II, Site No. 2, 4610 N. Lindbergh, Dept. 64C, St. Louis,
St. Louis County, MO - ST0005887, R0002046

Dear Mr. Haake:

The Missouri Department of Natural Resources' Hazardous Waste Program, Tanks Section, has received and reviewed a groundwater monitoring report dated May 10, 2002, submitted by The Boeing Company, for the above referenced site.

The report documents the laboratory results of the groundwater samples collected during April 2002. The laboratory results indicate petroleum hydrocarbon contamination is below the department's cleanup levels.

Based on a review of the analytical data and other information submitted, the department finds that no additional investigation or remedial action is currently required with regard to petroleum hydrocarbon spill/release. However, the department's finding is based solely on the information contained in these reports, and this finding does not constitute a certification or guarantee of the quality of the remedial action conducted or with regard to the lack of contamination on the property.

In the event a future petroleum hydrocarbon related environmental problem arises in the vicinity of this property, the department expressly reserves the right to require responsible parties to conduct additional investigation and/or remedial actions.


Please direct questions regarding the Petroleum Storage Tank Insurance Fund to the Fund Administrator at (573) 761-4060 or (800) 765-2765.

Mr. Joseph Haake
Page 2

If you have any questions, please contact the project manager for this site, Mr. Matt Alhalabi at (573) 751-6822.

Sincerely,

HAZARDOUS WASTE PROGRAM

A handwritten signature in black ink, appearing to read "Frederick J. Hutson". The signature is stylized with a large, looped "F" and a cursive "Hutson".

Frederick J. Hutson, R.G., Chief
Remediation Unit

FJH:maj

c: Mr. David Pate, Petroleum Storage Tank Insurance Fund
Mr. Mike Struckhoff, St. Louis Regional Office

APPENDIX I
ENVIRONMENTAL COVENANT

ENVIRONMENTAL COVENANT

This Environmental Covenant is entered into by and between _____ (“Owner”), and The Boeing Company (“Holder”), pursuant to the Missouri Environmental Covenants Act, Sections 260.1000 through 260.1039, RSMo.

PROPERTY USE CATEGORIES

For the purposes of this Environmental Covenant, the term “Residential Land Use” means land which has a dwelling erected upon it for human habitation. Any property on which a dwelling for human habitation is or could be located, or which is zoned for residential use, or which is or could be occupied by children under 18 years of age more than 250 days per year, is presumed by the Department to require protection to an unrestricted use standard. Properties not cleaned up to an unrestricted use standard are presumed by the Department not suitable for human-inhabited dwellings, for being zoned as residential, or for use as a school, daycare or child care facility. Use of a property for any other purpose that does not require protection to an unrestricted use standard is considered by the Department a “Non-residential Land Use.”

RECITALS

WHEREAS, Owner, whose mailing address is _____, is the owner in fee simple of certain real property commonly known and numbered as _____, and legally described as: [insert “legal description of the real property”] the “Property;”

WHEREAS, Owner desires to grant to the Holder, whose mailing address is 100 North Riverside Plaza, Chicago, Illinois 60606-1596, this Environmental Covenant for the purpose of subjecting the Property to certain activity and use limitations as provided in the Missouri Environmental Covenants Act;

WHEREAS, the Property is the subject of RCRA Corrective Action pursuant to the requirements of Hazardous Waste Permit No. OSO 62284002, issued by the Missouri Department of Natural Resources (the “Permit”); and

WHEREAS, the Permit required environmental investigation of the Property, which investigation revealed the presence of groundwater and soil contamination at various portions of the Property; the results of which are documented in a Remedial Facility Investigation Report, dated _____; and

WHEREAS, the Permit required preparation of a Corrective Measures Study, which evaluated and proposed various remedial and other measures to remove, contain and otherwise address environmental contamination documented by the Remedial Facility Investigation Report; and

WHEREAS, in support of the Corrective Measures Study, a risk assessment was performed to determine the clean-up levels for the contamination identified in the Remedial Facility Investigation Report consistent with the Property's current and anticipated future use as an airport related maintenance and manufacturing facility; the results of which are documented in a Risk-Based Corrective Action Report, dated _____; and

WHEREAS, the Missouri Department of Natural Resources has reviewed and approved the Remedial Facility Investigation Report, the Corrective Measures Study, and the Risk-Based Corrective Action Report and has determined that this Environmental Covenant will support completion of the RCRA Corrective Action requirements of the Permit by limiting future use of the property consistent with the assumptions underlying the Risk-Based Corrective Action Report and the Corrective Measures Study; and

WHEREAS, The term "Department" shall have the meaning given it in Section 260.1003(2) RSMo.

NOW THEREFORE, Owner, Holders, and the Department agree to the following:

1. Parties.

The Owner, the Holder and the Department are parties to this Environmental Covenant and may enforce it as provided for in Section 260.1030, RSMo.

2. Activity and Use Limitations.

As part of the implementation of institutional controls to support completion of the corrective actions required by the Permit, Owner hereby subjects the Property to, and agrees to comply with, the following activity and use limitations:

A. Restriction on Residential Use of the Property: This restriction applies to the Property shown in Figure 1. The Department has determined that the Property currently meets the Department standards for restricted use (Non-residential Land Use) and, based on reports on file at the Department offices in Jefferson City, Missouri, the Department has determined that the chemicals present no unacceptable present or future risk to human health or the environment based on restricted use of the Property. No further response action for the Property is required by the Department as long as the Property is not used for Residential Land Use or other purposes constituting unrestricted use. The Property may not be used in a manner such that the definition of Residential Land Use would define the use of the site. If any Owner desires in the future to use a portion or all of the Property for a restricted residential purpose, the Owner shall notify the Department 120 days in advance of such use and obtain Department approval for such use subject to conducting any further analyses and, as necessary, response action(s) as the Department may require as a condition of its approval. The Property may not be used in a manner that conflicts with this restriction.

B. Restriction on Use of Groundwater: This restriction applies to the Property shown in Figure 2. The groundwater beneath portions of the Property contains chemicals at concentrations that may currently exceed the maximum contaminant Levels (MCLs) or alternative risk based standards protective of drinking water. The Owner of the Property shall not install or maintain, and shall not permit the installation and maintenance of, groundwater extraction wells on the Property for use as a drinking water supply or for other domestic purposes which may result in human ingestion of the groundwater or dermal contact with the groundwater; any artificial penetration of the groundwater-bearing unit(s) containing chemicals which could result in cross-contamination of clean groundwater-bearing units. This restriction shall not preclude installation and maintenance of groundwater wells on the Property for purposes of investigating, characterizing, remediating, or monitoring the groundwater. Groundwater beneath the Property shall be monitored in accordance with specific requirements of the monitoring plan included in the Department approved Corrective Measures Study and as such plan may be periodically revised and approved by the Department. If any Owner desires in the future to use the groundwater on a portion or all of the Property for a restricted purpose, the Owner shall notify the Department 120 days in advance of such use and obtain Department approval for such use subject to conducting any further analyses and, as necessary, response action(s) as the Department may require as a condition of its approval. The Property may not be used in a manner that conflicts with this restriction.

C. Restriction on Agricultural Use of the Property. The Property shall not be used, and the Owner shall not permit use of the Property, for agricultural or other uses which may result in routine dermal contact by individual non-residential workers with surficial soils (defined as soils located zero to three feet below the ground surface) for 250 days or more for a cumulative period of 25 years or more. This restriction shall not preclude construction work on the Property notwithstanding that construction workers may have routine dermal contact with surficial soils, nor does this restriction preclude work involving grounds maintenance, installation and maintenance of landscaping and ornamental gardens, and/or installation and maintenance of irrigation systems associated with the foregoing. If any Owner desires in the future to use a portion or all of the Property for a restricted agricultural purpose, the Owner shall notify the Department 120 days in advance of such use and obtain Department approval for such use subject to conducting any further analyses and, as necessary, response action(s) as the Department may require as a condition of its approval. The Property may not be used in a manner that conflicts with this restriction.

D. Restriction on New Construction of Occupied Structures. This restriction applies to new construction on the Property shown in Figure 3 or to modification of existing structures to the extent that the modification substantially alters the foundation of the existing structure. Prior to construction of any new building which is intended to be occupied by people on a consistent and recurrent basis, Owner shall evaluate the proposed building for the potential of vapor intrusion

from residual chemicals in groundwater. This evaluation may include, for example, the implementation of the state of the practice models to estimate potential indoor air inhalation risk using the available groundwater data or the collection of additional soil vapor or other relevant data. If the results of such evaluations (pursuant to applicable federal and state standards) indicates an unacceptable vapor intrusion risk to human occupants, the building construction shall be modified as reasonably necessary to mitigate the risk from vapor intrusion from groundwater, including consideration of sub-foundation vapor barriers, ventilated crawl spaces, enhanced indoor ventilation or other features.

E. Restriction on Disturbance of Soil. This restriction applies to the portions of the Property shown in Figure 4. Soils at the Property contain chemicals, as identified in reports on file at the Department offices in Jefferson City, Missouri. Soils at the Property shall not be excavated or otherwise disturbed in any manner unless in accordance with the provisions of the Soil Management Plan incorporated in the Department approved Corrective Measures Study, which Soil Management Plan may be revised with approval by the Department. If any Owner desires in the future to exclude any portion of the Property from the Soil Management Plan, the Owner shall notify the Department 120 days in advance of such and obtain Department approval subject to conducting any further analyses and, as necessary, response action(s) as the Department may require as a condition of its approval.

3. Running with the Land.

This Environmental Covenant shall be binding upon Owner and its successors, assigns, and Transferees in interest, and shall run with the land, as provided in Section 260.1012, RSMo, subject to amendment or termination as set forth herein. The term "Transferee," as used in this Environmental Covenant, shall mean any future owner of any interest in the Property or any portion thereof, including, but not limited to, owners of an interest in fee simple, mortgagees, easement holders, and/or lessees.

4. Location of Administrative Record for the Environmental Response Project.

Further information regarding the administrative record for the environmental response project for the Property may be obtained from the Department through a written request under the Missouri Open Records Law, Chapter 610 RSMo, by providing the Department with the site identification name of The Boeing Company, Hazelwood to Missouri Department of Natural Resources, Attn: Custodian of Records, P.O. Box 176, Jefferson City, Missouri 65102-0176.

5. Enforcement.

Compliance with this Environmental Covenant may be enforced as provided in Section 260.1030, RSMo. Failure to timely enforce compliance with this Environmental Covenant or the activity and use limitations contained herein by any party shall not bar subsequent enforcement by such party and shall not be deemed a waiver of the party's right to take action to enforce any non-compliance. Nothing in this Environmental

Covenant shall restrict any person from exercising any authority under any other applicable law.

6. Right of Access.

Owner hereby grants to each of the Holder, the Department and their respective agents, contractors, and employees, the right of access at all reasonable times to the Property for implementation, monitoring or enforcement of this Environmental Covenant. Nothing herein shall be deemed to limit or otherwise affect the Department's rights of access and entry under federal or state law.

7. Compliance Reporting.

Owner/Transferee shall submit to the Department, by no later than January 31st of each year, documentation verifying that the activity and use limitations imposed hereby were in place and complied with during the preceding calendar year. Such reports shall be sent to the Department at the address that appears in paragraph 18 (Notice) below. The Department may change its mailing address by written notice to Owner/Transferee. The Compliance Report shall include the following statement, signed by Owner/Transferee:

To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

8. Additional Rights.

None.

9. Notice upon Conveyance.

Each instrument hereafter conveying any interest in the Property or any portion of the Property shall contain a notice of the activity and use limitations set forth in this Environmental Covenant, and provide the recording reference for this Environmental Covenant. The notice shall be substantially in the following form: THE INTEREST CONVEYED HEREBY IS SUBJECT TO AN ENVIRONMENTAL COVENANT, DATED _____, 20__, RECORDED IN THE OFFICE OF THE RECORDER OF DEEDS OF _____ COUNTY, _____, ON _____, 20__, AS DOCUMENT ____, BOOK ____, PAGE _____. Owner/Transferee shall notify the Holder and the Department within ten (10) days following each conveyance of an interest in any portion of the Property. The notice shall include the name, address, and telephone number of the Transferee, and a copy of the deed or other documentation evidencing the conveyance.

10. Notification Requirement.

Owner shall notify the Department following transfer of any interest in the Property or of any changes in use of the Property inconsistent with the Activity and Use Limitations specified in paragraph 2 above.

11. Representations and Warranties.

Owner hereby represents and warrants to the Holder and the Department that Owner has the power and authority to enter into this Environmental Covenant, to grant the rights and interests herein provided and to carry out all of Owner's obligations hereunder; that Owner is the sole owner of the Property and holds fee simple title, which is free, clear and unencumbered; to the extent that other interests in the Property exist, Owner has agreed to subordinate such interest to this Environmental Covenant, pursuant to Section 260.1006.4, RSMo, and the subordination agreement (attached hereto as Exhibit __ or recorded at _____); that Owner has identified all other parties who hold any interest (e.g., encumbrance) in the Property and notified such parties of Owner's intention to enter into this Environmental Covenant; and that this Environmental Covenant will not materially violate or contravene or constitute a material default under any other agreement, document or instrument to which Owner is a party or by which Owner may be bound or affected.

12. Amendment or Termination.

This Environmental Covenant may be amended or terminated by consent signed by the Department, the Owner, and the Holder. Within thirty (30) days of signature by all requisite parties on any amendment or termination of this Environmental Covenant, Owner/Transferee shall file such instrument for recording with the office of the recorder of the county in which the Property is situated, and within thirty (30) days of the date of such recording, Owner/Transferee shall provide a file- and date-stamped copy of the recorded instrument to the Department and the Holder.

13. Severability.

If any provision of this Environmental Covenant is found to be unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions shall not in any way be affected or impaired.

14. Governing Law.

This Environmental Covenant shall be governed by and interpreted in accordance with the laws of the State of Missouri.

15. Recordation.

Within thirty (30) days after the date of the final required signature upon this Environmental Covenant, Owner shall record this Environmental Covenant with the office of the recorder of the county in which the Property is situated.

16. Effective Date.

The effective date of this Environmental Covenant shall be the date upon which the fully executed Environmental Covenant has been recorded with the office of the recorder of the county in which the Property is situated.

17. Distribution of Environmental Covenant.

Within thirty (30) days following the recording of this Environmental Covenant, or any amendment or termination of this Environmental Covenant, Owner/Transferee shall, in

accordance with Section 260.1018, RSMo, distribute a file- and date-stamped copy of the recorded Environmental Covenant to: (a) each signatory hereto; (b) each person holding a recorded interest in the Property; (c) each person in possession of the Property; (d) each municipality or other unit of local government in which the Property is located; and (e) any other person designated by the Department.

18. Notice.

Any document or other item required by this Environmental Covenant to be given to another party hereto shall be sent to:

If to Owner:

[name]

[address]

If to Holder:

[name]

[address]

If to Department:

[name]

[address]

The undersigned represent and certify that they are authorized to execute this Environmental Covenant.

IT IS SO AGREED:

FOR OWNER

By: _____ Date: _____

Name (print):

Title:

Address:

[Consult Section 442.210, RSMo for acknowledgement requirements.]

STATE OF _____)

)

COUNTY OF _____)

On this ____ day of _____, 20__, before me, a Notary Public in and for said state, personally appeared (Name), (Title) of _____ (Corporate Name), known to me to be the person who executed the within Environmental Covenant on behalf of said corporation and acknowledged to me that he/she executed the same for the purposes therein stated.

Notary Public

FOR HOLDERS

By: _____ Date: _____

Name (print):

Title:

Address:

STATE OF _____)

)

COUNTY OF _____)

On this ____ day of _____, 20__, before me, a Notary Public in and for said state, personally appeared (Name), (Title) of _____ (Corporate Name), known to me to be the person who executed the within Environmental Covenant in behalf of said corporation and acknowledged to me that he/she executed the same for the purposes therein stated.

Notary Public

FOR DEPARTMENT

By: _____ Date: _____

Name (print):

Title:

Address:

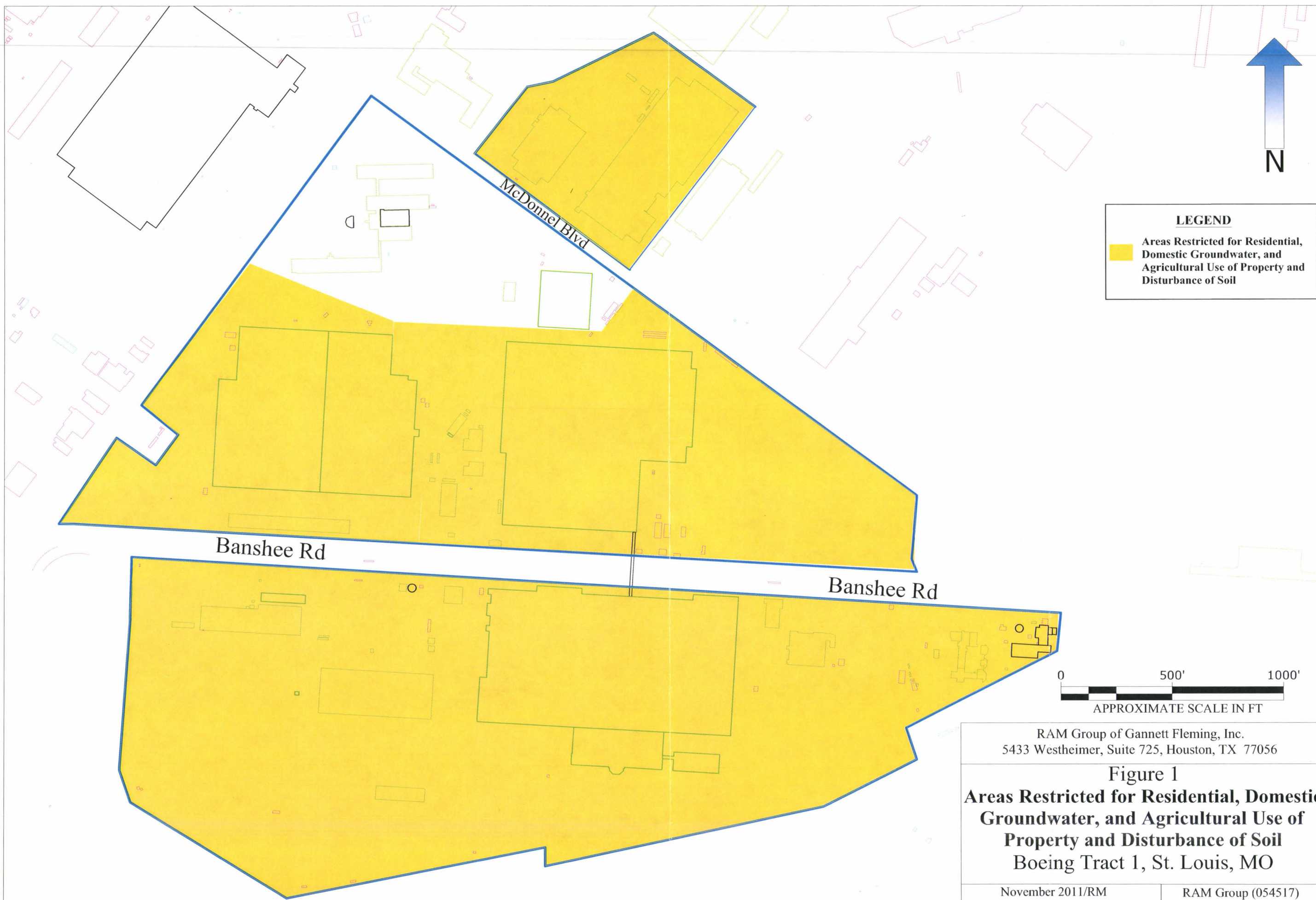
STATE OF _____)

)

COUNTY OF _____)

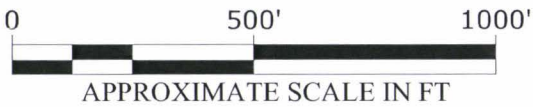
On this ____ day of _____, 20__, before me, a Notary Public in and for said state, personally appeared (Name), (Title) of _____ (Corporate Name), known to me to be the person who executed the within Environmental Covenant in behalf of said corporation and acknowledged to me that he/she executed the same for the purposes therein stated.

Notary Public



LEGEND

Areas Restricted for Residential, Domestic Groundwater, and Agricultural Use of Property and Disturbance of Soil



RAM Group of Gannett Fleming, Inc.
5433 Westheimer, Suite 725, Houston, TX 77056

Figure 1
Areas Restricted for Residential, Domestic Groundwater, and Agricultural Use of Property and Disturbance of Soil
Boeing Tract 1, St. Louis, MO

November 2011/RM	RAM Group (054517)
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